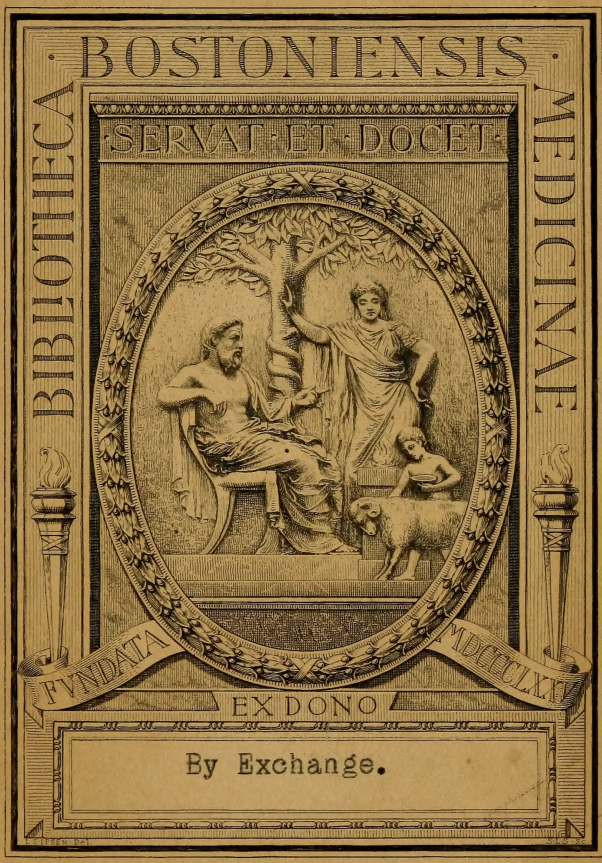
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# A MANUAL

OF THE

# DISEASES OF THE EYE

BY

C. MACNAMARA, F.R.C.S.

SURGEON TO THE ROYAL WESTMINSTER OPHTHALMIC HOSPITAL; SURGEON AND LECTURER ON SURGERY, WESTMINSTER HOSPITAL; SURGEON-MAJOR H.M. INDIAN MEDICAL SERVICE

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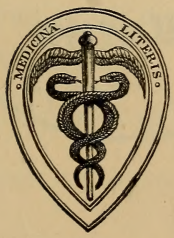


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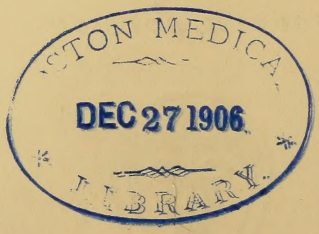

This Volume is Dedicated

TO

ADOLF ALT, M.D.,

LECTURER ON OPHTHALMOLOGY IN THE TRINITY MEDICAL SCHOOL, TORONTO,

IN ACKNOWLEDGMENT OF THE ASSISTANCE AFFORDED THE AUTHOR IN REVISING THIS EDITION OF HIS WORK FROM THE STUDY OF

*DR. ALT'S LECTURES ON THE PATHOLOGICAL CONDITIONS OF THE HUMAN EYE,*

AND AS A

SLIGHT TOKEN OF THE VALUE IN WHICH HE HOLDS

DR. ALT'S CONTRIBUTIONS TO OPHTHALMOLOGICAL SCIENCE.

# PREFACE

TO

# THE FOURTH EDITION.

THE present edition of this work has been extensively revised. I have entirely re-written the chapters on Errors of Refraction of the Eye, and also those on Diseases of the Choroid, Optic Nerve and Retina. My endeavour in the following pages has been to describe the practice carried on in a large Ophthalmic Hospital, rather than to discuss the views of various authorities on ophthalmology. Not that I ignore the value of the work which is being done by surgeons in this and other parts of the world, but to a large extent the result of their labours is sifted out in hospital practice, and much of what is sound clings to, and infuses itself into, our everyday work, and will therefore, I hope, be found fairly described in this volume. My efforts have been directed towards producing a work from which students may learn the diagnosis, pathology and treatment of diseases of the eye, and to which busy practitioners

may refer for definite information when in doubt as to the nature of ophthalmic cases under their care.

I am much indebted to my friend, Dr. G. L. Johnson, for the able description of the Anatomy of the Eye which he has written for me, and which will be found in the opening pages of this volume. My best thanks are also due to Mr. Albert Leahy, one of my colleagues at the Royal Westminster Ophthalmic Hospital, for the kind help he has given me in revising a portion of these pages as they passed through the press.

13, Grosvenor Street, W.

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## CORRECTION.

At page 351, fourth line from end of page, *read*—"of the eyeball has followed," *not* "eyeball lens follows."

## CHAPTER XV.

DISEASES OF THE LENS.

Pathology of Cataract—Lenticular Cataracts—Soft—Cortical—Hard—Treatment—Preparation of Patient—Operation—Depression—Solution—Flap Extraction—Modifications—Linear Extraction—Traction Operation—Modified Linear Extraction—Linear Extraction without Iridectomy—Choice of an Operation—Capsular Cataract—Traumatic Cataract—Dislocations of the Lens. pp. 401—448

## CHAPTER XVI.

# PLATE I.

FIG. 1.—*Conjunctivitis.*—Both the orbital and palpebral vessels of the conjunctiva are deeply congested. The everted lid is red and swollen, numerous vessels are seen ramifying over the sclerotic, appearing to terminate at the margin of the cornea. The fibrous structure of the iris is well marked.

p. 140.

FIG. 2.—*Plastic Iritis.*—A pink zone of sclerotic injection is seen surrounding the margin of the cornea. The fibres of the iris are indistinct, and the margin of the pupil irregular; this condition is well brought out by comparing Figs. 1 and 2 of this Plate.

p. 246.

PLATE I.

I

II

West, Newman & Co. ad nat. lith.

## PLATE II.

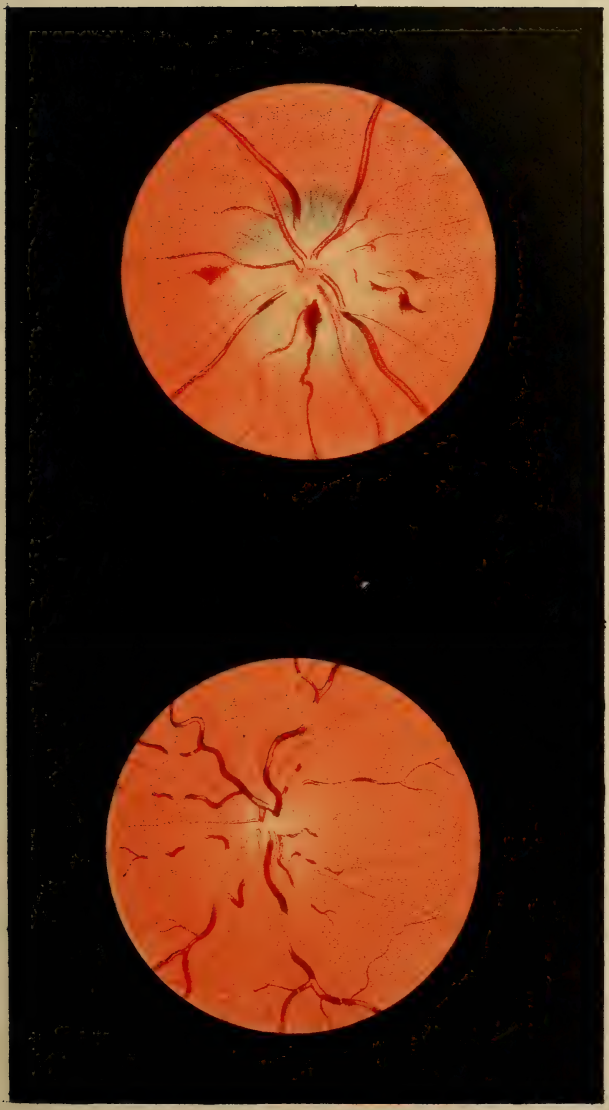
FIG. 1.—*Optic Neuritis.*—The papilla is much swollen and striated; the outline of the disc is entirely hid from view. The retinal arteries are diminished in calibre; the veins, on the other hand, are congested.

p. 323.

FIG. 2.—*Neuro-retinitis.*—The optic disc is concealed by the engorged vessels of the papilla, and is of the same deep scarlet colour as the retina. The central artery is of its natural size, but the veins are much engorged with blood.

p. 330.

PLATE II.



I

II

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# PLATE III.

FIG. 1.—*Opaque Nerve-Fibres.*—This figure shows an extreme degree of opaque nerve fibres; it is seldom so extensive a portion of the retina is occupied with fibres of this description. The soft margin of the opaque area, its white colour, and the passage of retinal vessels over and through the opaque fibres is well illustrated.

p. 317.

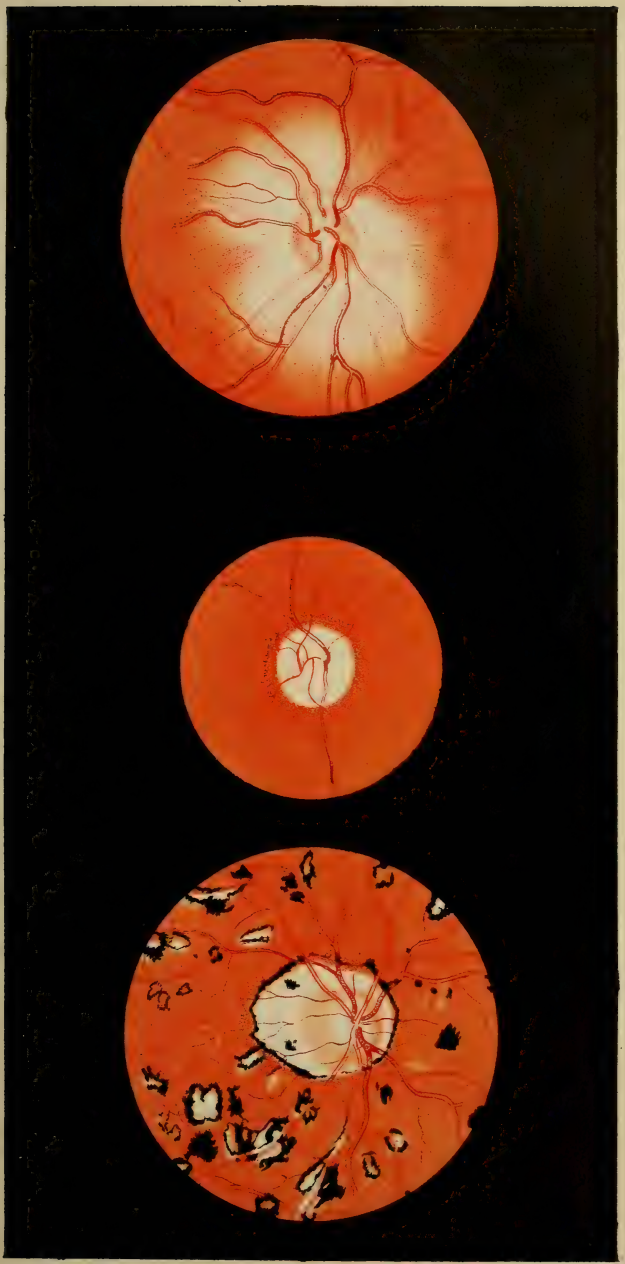
FIG. 2.—*Atrophy of the Optic Disc.*—The perfectly white colour of the optic disc is marked. The retinal arteries are constricted; the veins of their natural size.

p. 333.

FIG 3.—*Sclero-choroiditis Posterior, and Atrophy of the Choroid.*—A large posterior staphyloma almost surrounds the optic disc; its background is white, being formed by the sclerotic. Scattered over the fundus of the eye are several spots of atrophied choroid, surrounded by a margin of black pigment.

p. 310.

PLATE III.



I

II

III

West, Newman & Co. Lith.

## PLATE IV.

FIG. 1.—*Retinitis Pigmentosa.*—The characteristic black patches of this affection cover the outer part of the retina, and in many places pass along the course of its vessels.

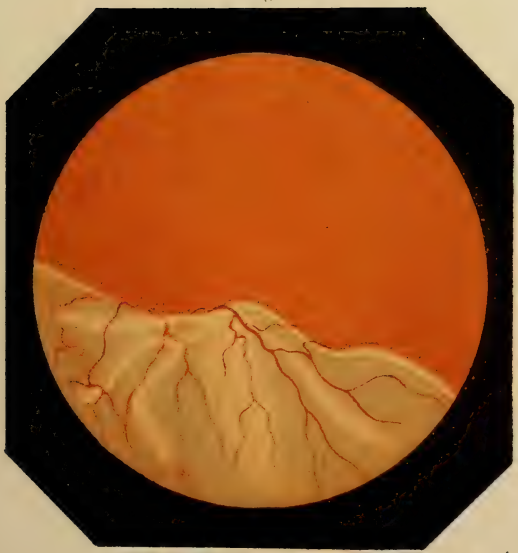
p. 359.

FIG. 2.—*Detachment of the Retina.*—The detached portion of the retina is of a grey colour, the retinal vessels bending over it; if these vessels are accurately focussed the optic disc is not seen, because it is on a plane posterior to the detached portion of the retina.

p. 367.

*Fig. I.*

*Fig. II*



J.H.F. Rippon lith. Hanhart imp.

# CHAPTER I.

*The Anatomy of the Capsule of Tenon—Muscles of the Eye—Sclerotic — Cornea—Angle of Anterior Chamber — Lymphatic System of the Eye—Vitreous—Canal of Petit—Lens—Tunica Vasculosa—The Ciliary Muscle—Iris and Retina—The Accommodation of the Eye.*

## THE ANATOMY OF THE EYE.

By George Lindsay Johnson, M.A., M.B., Cantab.

In the following description of the Anatomy of the Eye only the points of surgical or pathological interest will be dwelt on. Anatomy of Eye.

*Capsule of Tenon* (orbito-ocular fascia). Fig. 1.—The dura mater, in passing over the sphenoid bone, sends prolongations of its fascia into the orbit through the sphenoidal fissure and optic foramen. These, blending together, line the walls of the orbit, and at its outer margin become directly continuous with the periosteum of the frontal and facial bones. This fascia is loosely attached to the bones of the orbit, but at the anterior margin of the orbit, where it passes on to the facial bones, it is very strongly attached; a portion of this fascia covers the tarsal ligaments. As the dura mater passes through the optic foramen it splits up into two portions, one, as above described, goes to line the orbit; the other passes forwards to form a sheath for the optic nerve and the posterior three-fourths of the eyeball forming the *true capsule of Tenon*.* This fascia, though ostensibly to separate the eyeball from the orbital muscles and fat, and to enable it to roll freely in all its Capsule of Tenon. True Capsule of Tenon.

* "Traité Pratique d'Anatomie," p. 433.

movements, is really a serous membrane, lined throughout by flattened epithelioid cells, continuous with the cells forming the outer layer of the arachnoid, and containing a space, easily shown by injections to be directly continuous with the arachnoid space of the brain. This space has received the name of Tenon's space, and though in health, like the pleural "cavity," it can hardly be said to exist, yet it is capable of injection all round the eyeball, forward beyond the insertion of the recti to a point immediately behind the sclero-corneal margin. Here the capsule merges into the sclerotic and conjunctiva; the remainder passes behind the conjunctiva to the tarsal ligament, where it is continuous with the periosteum, thus forming a large sac, holding everything within the orbit except the eyeball and optic nerve (Fig. 1).*

The tendons of the ocular muscles pierce this membrane obliquely, about a line behind their insertion into the sclerotic. A number of delicate processes of connective tissue connect the tendons with the capsule of Tenon at this point; in fact, these muscles may be said to be inserted, not only into the sclerotic, but also into the capsule. In addition to this, all the muscles of the orbit receive delicate investments from the capsule of Tenon, and a layer of especial density forms an investment for the lachrymal sac and the lachrymal gland, which it binds down to the periosteum. Lastly, numerous delicate prolongations of the fascia pass into the orbit, to form a kind of support for the semi-liquid fat, which fills up the rest of the orbit. In many parts of the fascia unstriped muscular fibres, together with fibres of elastic tissue, have been detected. These are supposed to restore the capsule to its proper shape when disturbed by the action of the muscles. Filaments from the cervical sympathetic nerves supply them.

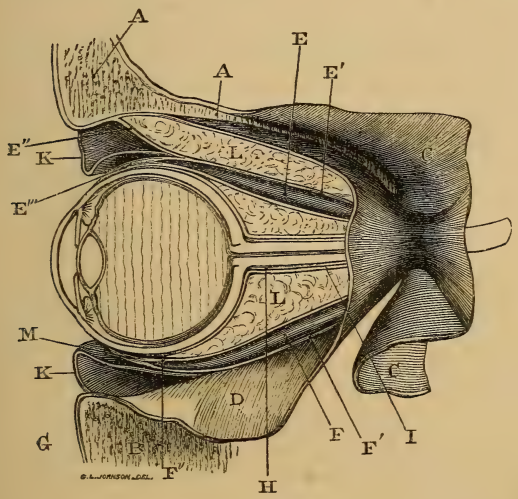
Muscles of Eyeball.

*The Muscles of the Eyeball.*—The tendons of the recti muscles pass forwards, one above, one below, and one on either side of the eyeball. They become flattened out as they lie close to the globe, and, becoming tendinous, pass beneath Tenon's cap-

* "Traité des Maladies des Yeux," par X. Galezowski, p. 823, Richet, p. 434.

sule to be inserted about a third of an inch behind the corneal margin. At the point of emergence from Tenon's capsule a fasciculus from the main tendon passes outwards (*i.e.*, away from the globe) to be inserted into the periosteum of the orbit (Fig. 1, E″). Anatomy of Tendons of Ocular Muscles.

FIG. 1.




Diagrammatic Section through the Orbit, showing the reflections of the Oculo-orbital Fascia. (After Richet.)

A A. Frontal bone.
B. Superior maxilla.
C C. Dura mater.
D. Orbital portion of the orbito-ocular sheath.
E. Superior rectus muscle.
E′. Its sheath.
E″. Its orbital tendon.
E‴. Its ocular tendon.
F. Inferior rectus muscle.
F′. Its sheath.
F′. Its ocular tendon.
G. Periosteum of the facial bones.
H. Inner sheath of the optic nerve.
I. Outer sheath (Tenon's capsule).
K. The fascia which connects Tenon's capsule with the periosteum of the orbit.
L L. Fat of the orbit.
M. Portion of Tenon's capsule in front of the muscle.

Each of the recti sends off a similar offshoot to the orbital fascia The use of these fasciculi is to suspend the eye in the centre of the orbit at an equal distance from its walls, and to hold the lobe in a fixed position, so that it is only free to move round its

own axis.* The main body of the muscular tendon is continued into the sclerotic, its margins spreading out into a thin fascia common to the recti, so that these muscles may be said to be inserted into the whole circumference of the eyeball. The use of this is obviously to distribute the tension of the muscles equally over the whole globe, so as to secure a perfectly smooth and uniform floor for the reception of the retina.

The recti at their insertion form a spiral, each muscle being inserted one millimètre nearer the corneal border than its fellow. The insertions of the superior, external, inferior, and internal recti, being respectively $8^{mm}$, $7^{mm}$, $6^{mm}$, and $5^{mm}$ from the corneal border. In tenotomy for external squint, the greater distance of the insertion of the external rectus from the cornea should be borne in mind.

THE SCLEROTIC.

*The Sclerotic.*—The sclerotic consists of closely interwoven connective tissue fibres intermixed with fine elastic tissue. The two sheaths of the optic nerves get rapidly thick as they approach the eyeball. At the point where they reach the choroid they bend round at right angles and unite, receiving the name of the sclerotic. This coat extends over five-sixths of the eyeball, joining in front with the cornea. The recti and obliqui tendons, spreading out at their insertion, also materially assist in strengthening the sclerotic, and contributing to its substance. Distributed among the fibres are numerous connective-tissue corpuscles lying in cell-spaces; they are identical with those of the cornea, but are less regularly arranged. A few bloodvessels permeate the sclerotic, in the form of a network of capillaries with very wide meshes. In the neighbourhood of the cornea a zone of greater vascularity exists. It is invisible in health, but in inflammatory conditions of the ciliary body and iris becomes very marked as a rosy zone of vessels encircling the cornea.

The sclerotic continues to increase in size until about the twentieth year, when it ceases to grow. During its development, it is evident that anything which tends to weaken or soften

* For further information on this interesting subject see Richet, "Anatomie Médico-Chirurgicale," 15th ed., p. 438.

the tissue, or to cause an unnatural strain on any part of its surface, will result in a permanent alteration in the shape of the globe and tend to develop myopia or staphyloma.

*The Cornea* is a continuation of the sclerotic, but with its tissue modified so as to become perfectly transparent, and destitute of bloodvessels. The transition of sclerotic into corneal tissue is very abrupt and sudden. THE CORNEA.

The cornea consists of four layers :—

1. The External Epithelium Layer, continuous with the conjunctiva. This consists of eight or nine layers of cells, made up of a basement-layer of columnarcells with well-marked nuclei, several layers of oval or spherical cells, and finally, three or four strata of flattened cells on the surface. Many of the cells of the deeper layers are furnished with minute processes or prickles, and dovetail into each other.

2. The Proper Tissue of the Cornea. This consists of a modified form of connective tissue, arranged in alternating lamellæ running at right angles to each other, sixty to seventy in number. As all the fibres have the same refractive index, it is only by re-agents, or by post-mortem changes, that any structure can be made out. These fibres are collected into bundles arranged in layers, each layer being separated from the next one by a homogeneous matrix. In this latter lie the cell-spaces. These are many-branched flat cavities or lacunæ, freely anastomosing with similar lacunæ on all sides, by narrow irregular-shaped canaliculi, and called the lymph canalicular system. They are merely excavations in the matrix, having no lining membrane. Each lacuna is almost entirely filled up by a flat cell, the corneal corpuscle. Each cell consists of a hyaline substance, in the centre of which is a large oval nucleus surrounded by a dense reticulum of fibrils. The substance of the cell is prolonged by fine processes, through the canaliculi anastomosing with processes of neighbouring cells. Between the corpuscle or its process and the lacunar wall there is just room for the passage of lymph and migratory cells, so that leucocytes can pass in this way from one side of the cornea to the other, or even right round the eyeball, since (as we have previously stated) this canalicular system is continued throughout the sclerotic. Moreover, as there is a

network of these lacunæ between every two layers of corneal fibres, the amount of lymph circulating through the cornea and sclerotic is very great. Many of the corneal corpuscles undergo distinct amœboid movements during life. There are no proper lymphatic vessels in the cornea, though the lymphatics of the conjunctiva anastomose at the margin of the cornea with the above-mentioned lacunar system,* and the latter carries on their work. The corneal tubes of Bowman have lately been proved to be artificial products.

A narrow layer of the corneal substance immediately beneath the epithelium is destitute of corneal corpuscles and lamellæ, and presents a more uniform appearance than the rest of the cornea. Bowman first named it the Anterior Elastic Lamina, though it has no claim to be considered a distinct membrane.

3. The Posterior Elastic Lamina of Bowman (Membrane of Descemet) forms a distinct structureless hyaline layer of uniform thickness throughout, lining the posterior surface of the cornea proper. It is highly elastic, and when partly detached tends to roll inwards on itself.

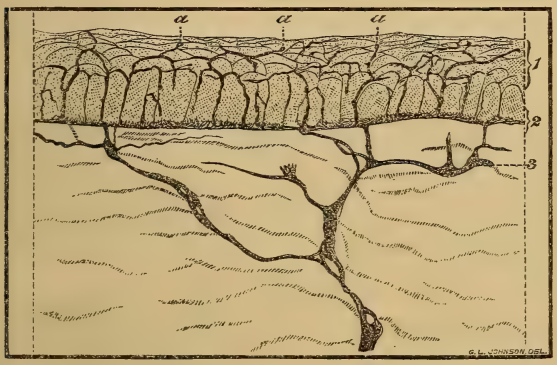
4. The posterior surface of this membrane is covered with a single layer of cubical or slightly flattened endothelial cells, each having a single oval nucleus.

*Nerves of the Cornea.*—The cornea is supplied entirely by the ciliary nerves. They enter the fore part of the sclerotic near the cornea, and after sending branches to the ciliary muscle and iris, form a plexus round its margin. From this network an immense number of non-medullated nerve-fibres pass forwards, dividing and subdividing as they approach the epithelial surface, and finally form a dense network or plexus, distributed equally over the whole surface of the cornea just beneath the anterior elastic lamina. This primary plexus (Fig. 2, 3) gives off a number of very slender fibres which, piercing the lamina, form a secondary plexus (Fig. 2, 2) immediately beneath the conjunctiva. From this a set of fibres proceed upwards, between the epithelial cells to the surface, and thence curving backwards, form a network in the middle of the conjunctiva (Fig. 2, 1). From this plexus

* Klein, "Atlas of Histology," p. 346.

the ultimate fibres proceed, ending close to the surface in little bulbous expansions resembling minute Pacinian corpuscles (Fig. 2, *a*, *a*, *a*).* The proximation of these terminal nerve-bulbs to the surface may help to explain the intense pain and photophobia which exists when an abrasion of the corneal epithelium or an ulcer exposes them to the air or pressure from without.

FIG. 2.




Angle of Anterior Chamber.

*The Angle of the Anterior Chamber.*—The angle of the anterior chamber is the space bounded by the iris behind and the endothelium covering Descemet's membrane in front. This endothelial membrane forms a lining to the sides of the angle; covering first Descemet's membrane, next at the angle itself, the ligamentum pectinatum, and lastly, as it becomes reflected, the anterior surface of the iris. The whole of the anterior chamber (with the exception of the pupillary opening) is therefore lined throughout by this endothelial membrane.

At a distance of one millimètre from the angle, Descemet's membrane becomes suddenly attenuated; it is continued over the

* Ranvier, "Leçons sur les Terminations Nerveuse Cornée," 1879. Klein asserts that many of the nerve-fibrils terminate in an exceedingly delicate network of fibrils on the surface of the corneal corpuscles.—*Atlas of Histology*, p. 348.

ligamentum pectinatum and passes directly into the delicate basement membrane of the anterior surface of the iris.*

Ligamentum pectinatum.

At the point where Descemet's membrane narrows, it becomes connected with a number of elastic fibres which, interlacing and becoming more numerous as they pass outwards, expand towards the angle into a kind of spongy tissue. The trabecular part of this tissue is not only connected with the marginal ring of the membrane of Descemet, but also enters into and form the anterior root of origin of the iris, the ligamentum pectinatum iridis. The spaces formed by the above trabeculæ are lymph

FIG. 3.

Horizontal Section through the Tissues around the Angle of the Anterior Chamber.

*a*. Ligamentum pectinatum.
*b*. Prolongation of the Iris.
*c*. Canal of Schlemm.
*d*. Bloodvessels.
*e*. Spaces of Fontana.
*f*. Descemet's membrane.
C, ciliary body; M, ciliary muscle; Sc., Sclerotic; E E, Epithelium. (After De Wecker.)

Spaces of Fontana.

channels, and are called the spaces of Fontana. This spongy tissue, then, is bounded in front by the junction of the cornea and

* Klein, "Atlas of Histology," p. 350.

sclerotic and the canal of Schlemm, behind by the anterior root of the iris ; internally it is separated from the endothelium by the marginal ring of Descemet's membrane, and externally it is connected with and bounded by the fibres of origin of the ciliary muscle.

Canal of Schlemm.

The canal of Schlemm is a constant well-marked canal encircling the fore part of the eye. It is situated in the sclerotic, close to its junction with the cornea, and only separated from the anterior chamber by the ligamentum pectinatum (with which it lies in contact), and Descemet's ring and endothelium. The most recent experiments point to its being a vein.* The canal communicates on the one hand, "by fine clefts and holes with the spaces of the ligamentum pectinatum, and through them with the anterior chamber" (Klein) ; and, on the other hand, with the adjacent inter-fascicular lymph-spaces of the sclerotic, which we mentioned before.

The Lymphatic System of the Eye.

*The Lymphatic System of the Eye.*—As all bloodvessels are more or less opaque, it becomes a matter of necessity for uninterrupted vision that the conducing media should be nourished in some other way. This is afforded by the circulation of colourless lymph. Any disturbance of this circulation of lymph, either by affording an increased or diminished flow, or by obstructing its escape, is immediately followed by an alteration in the tension of the globe, and if considerable or prolonged, will lead to structural changes in the eyeball itself.

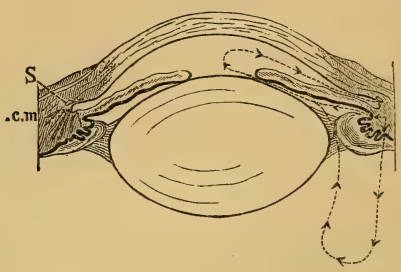
The lymph formed in the tissues of the eye is discharged from them along three different paths. That portion which is secreted by the iris and ciliary processes finds its way to the angle of the anterior chamber, and thence percolates through the spaces of Fontana to the canal of Schlemm, and so on (Fig. 4). This constitutes the anterior lymphatic system.

All those parts of the globe situated behind the ciliary body and outside the vitreous chamber discharge their lymph in one of two ways—that from the choroid and sclerotic escaping along the sheath of the venæ vorticosæ, that from the retina by a

* Leber, "Anatomische Untersuchungen über die Blutgefässe des menschlichen Auges."

tract within the optic nerve. The two last-named tracts constitute together the posterior lymphatic system.

FIG. 4.




View of the Anterior Part of a Healthy Adult Human Eye divided horizontally through the middle, and intended to show the normal shape of the angle of the anterior chamber and the comparative size of the different parts in health. The drawing was taken from a specimen frozen in gum, and the parts carefully drawn to scale. The dotted line shows the path of lymph from the ciliary body to Schlemm's canal. Magnified four diameters.

Lymphatic System of the Eye.

1. *The System of the Anterior Chamber of the Eye.*—The iris and ciliary body form the chief sources of lymph supply for the nourishment of the vitreous and lens. The lymph, after circulating through the vitreous passes into the canal of Petit, and thence through a series of fine fissures which exist in the zonula ciliaris, close to the border of the lens, into the posterior chamber. From this it passes between the iris and the capsule of the lens into the anterior chamber. Under normal conditions the iris rests against the lens so closely as to form a kind of valve, which only allows of a current in a forward direction, any pressure in the anterior chamber only shutting the valve the closer; nor can this resistance be overcome except by a change of form of the globe of the eye, as results from increased intra-ocular pressure, which may be artificially produced by injections into the anterior chamber.

The lymph of a large portion of the ciliary body and iris is secreted directly into the posterior chamber, and accompanying the former current passes forwards through the valve, to meet a

third stream, which finds its way into the anterior chamber through the meshes of the ligamentum pectinatum (Fig. 4). Minute fissures exist in Descemet's membrane and endothelial covering in the neighbourhood of the angle of the anterior chamber, by which communication is established. The lymph in the anterior chamber discharges itself into the canal of Schlemm through similar meshes near the point of constriction of Descemet's membrane, and thence into the anterior ciliary veins. The lymph returning through the canalicular spaces of the sclerotic and cornea also joins the main stream at the canal of Schlemm. Lymphatic System of the Eye.

The manner in which the canal of Schlemm is connected with the veins in its vicinity is still unknown. In all probability certain valvular arrangements exist which prevent the passage of venous blood into the canal of Schlemm under the normal conditions of pressure. Were the lymph of the anterior chamber to empty itself directly into the lymphatics, so rapid an outflow would occur that the sluggish transudation of fresh fluid into the chamber could not be possibly compensated for, and the cornea would collapse. This, however, is avoided by the intervention of the canal of Schlemm, which does duty as a "regulator" between the two (Schwalbe). The fact that in the small veins the pressure is always higher than in the corresponding lymphatics, and the resistance which the trabecular meshes offer to the outflow, also tend to equalize the two streams. Injections into the anterior chamber can be readily made to pass into the anterior ciliary veins in the above manner. The anterior chamber does not communicate directly with the perichoroidal space, or Tenon's space, or with the lymphatics of the conjunctiva—but it does so indirectly through the communications of the spaces of Fontana with the canalicular system.

Lastly, there is a current of lymph from the vitreous which enters the substance of the lens through the external layers of its posterior half (Weiss).

2. *The Posterior Lymphatic System.* (Fig. 5.)—(A.) The Lymphatics of the Choroid and Sclerotic.—The lymph from these membranes passes directly into a lacuniform space situ-

Lymphatic System of the Eye.

ated between the sclerotic and choroid throughout their whole extent from the ciliary body to the optic nerve (Fig. 5, *pch.*)

Fig. 5.

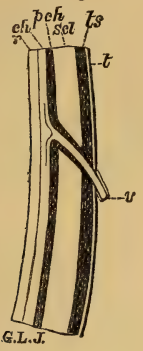



Diagram showing the Communication between Tenon's Space and the peri-choroidal Lymph Channel. *r*, retina; *scl*, sclerotic; *ts*, Tenon's space; *t*, Tenon's capsule; *v*, vena vorticosa; *pch*, peri-choroidal spaces. (Copied from Schwalbe, in Stricker's Handbook.)

This space is not patent, as in the diagram, but its walls are held together by a trabecular tissue, composed of numerous very flat lamellæ made up of elastic fibres and branched nucleated connective-tissue corpuscles. The lamellæ are covered with an endothelium like that of ordinary lymphatic canals, and are separated from one another by more or less continuous lymph spaces. That portion of the tissue which adheres to the sclerotic after removal of the choroid is termed the lamina fusca, that next the choroid the supra-choroidal tissue, and the space between, the peri-choroidal space. On the outer side of the sclerotic is another very similar lymphatic channel, which we have already described as Tenon's space. The blood of the choroid is removed by four large veins—the venæ vorticosæ which, piercing the sclerotic obliquely at a point midway between the optic nerve and the cornea, open directly into the ophthalmic vein. A peri-vascular lymphatic sheath communicating with both the above spaces, surrounds each vein in its passage through the sclera, and hence the lymph flows readily from the peri-choroidal to Tenon's space. At the posterior pole of the eye around the entrance of the optic nerve, Tenon's capsule forms a covering for the external sheath of the optic nerve; between these two, therefore, is the continuation of Tenon's space (supra-vaginal space), which we have already described as opening directly through the canalis opticus into the arachnoid cavity of the brain.

(B.) The Lymphatics of the Retina.—These are peri-vascular canals similar to those round the vessels of the brain and spinal cord. The veins and capillaries are completely invested by these sheaths, but the arteries only partially so. A minute

serous cavity also exists between the membrana limitans interna and the nerve-fibre layer which communicates with these channels. The lymph passes out of the eye through the lamina cribrosa.

Lymphatic Spaces in Sheath of Optic Nerve.

(C.) The Lymphatics of the Optic Nerve.—The optic nerve is invested by three sheaths, which are prolongations of the dura mater, arachnoid and pia mater respectively. The external, or dural sheath, is a firm, tough sheath identical in structure with the dura mater, and joins the nerve at the foramen. The middle, or arachnoidal sheath, consists merely of a network of fine connective tissue fibres, in the meshes of which are endothelial cells. In the normal eye there is no space between it and the external sheath ; hence many anatomists consider the two as one, and recognize only two sheaths—an outer and an inner one. The internal, or pial sheath, is a continuation of the pia mater, which follows the nerve from the chiasma to the bulb. Its outer part contributes the sub-arachnoid (inter-vaginal) trabeculæ, which fill the intervaginal space. From its inner part a strong trabecular framework of fibro-cellular tissue is derived, which forms a dense network throughout the optic nerve, ensheathing and supporting the nerve-bundles and giving off thin septa of connective tissue which surround each individual fibre. This framework also carries the bloodvessels and capillaries which supply the nerve. In addition to the above sheaths, and surrounding all, is Tenon's capsule, which joins its orbital portion as well as the external sheath at the foramen.

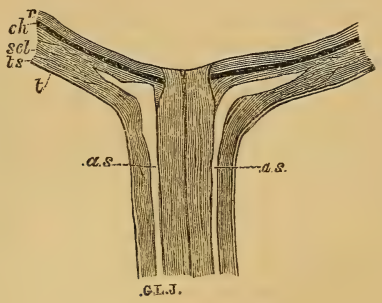
Surrounding the external "dural" sheath of the nerve we have the supra-vaginal space of Schwalbe ("Tenon's space") as described above.

Between the external and middle sheaths is a lymph-space, which, according to De Wecker, only exists in disease. This also opens into the arachnoid cavity of the brain, but does not communicate either with the peri-choroidal space or the sub-arachnoid cavity of the nerve. It ceases just behind the commencement of the choroid. Between the middle and internal "pial" sheath is a constant, well-defined space—the sub-arachnoid or inter-vaginal space of De Wecker (Fig. 6, *sa.*) "This space is permeated by a loose spongy mass of anastomosing trabeculæ of connective tissue, connected with the arachnoidal

Lymphatic System of the Eye.

sheath, and covered with an endothelial membrane" (Klein). Near the insertion of the nerve into the globe the space dilates

FIG. 6.




Semi-diagrammatic Sketch of the Sub-arachnoid Space and Sheaths of the Optic Nerve. The trabeculæ and arachnoid sheath are omitted. *r*, retina; *ch*, choroid; *scl*, sclerotic; *sa*, sub-arachnoid. (After De Wecker.)

into an ampulla, which extends a short distance under the choroid in a conical form, separated only from the latter by the pial sheath, and terminates more or less abruptly. At the level of the laminæ cribrosæ it anastomoses with the lymph-spaces between the pial sheath and the nerve-bundles by means of lymph-canalicular clefts in the pial sheath, and at its termination under the choroid it communicates with the peri-choroidal lymph-space above described. Finally, beneath the pial sheath a lymph-space exists which is continuous with lymph-channels running through the trabecular framework of the optic nerve and between the individual fibres. This space does not communicate with the sub-arachnoid space of the optic nerve.

Vitreous.

*The Vitreous Humour and Canal of Petit.*—The vitreous is not a secreted fluid like the aqueous, but an embryonic product of mesoblastic tissue which enters the hyaloid cavity through the choroidal fissure at a very early stage of fœtal life. It can therefore never be restored. When a portion escapes from the eye its place is filled by lymph, which, fortunately, having a similar refractive index does not cause any sensible loss of vision.

The anterior surface presents a cup-shaped cavity, the patel-

lar fossa, in which lies the lens in its capsule. "The vitreous is enclosed in a capsule, the hyaloid membrane. The capsule is closely applied to the membrana limitans interna of the retina throughout its whole extent from the optic nerve to the ora serrata. From this point it loses its hyaline character, and becomes thicker and fibrillated. It does not cover the patellar fossa of the vitreous, but passes forwards from the apices of the ciliary processes to the anterior part of the margin of the lens, thus forming the anterior wall of the lymphatic canal known as the canal of Petit" (Klein).* This latter portion of the hyaloid membrane is known as the *suspensory ligament of the lens*, or *Zonula of Zinn*. It is by far the strongest and thickest portion of the hyaloid, and its hyaline matrix is strengthened by bundles of thin, stiff elastic fibres. It is now admitted by the best authorities that the triangular space encircling the margin of the lens, and known as the canal of Petit, has no posterior lining membrane, the vitreous extending right up to the suspensory ligament, at least only leaving room for a microscopic lymph space between; and that the triangular canal is really due to the shrinking, and consequent recession of the vitreous after death. The surface of the vitreous becoming condensed at this part, has led to the further mistaken idea of a posterior lining membrane to the cavity. In the frozen eyes that I have examined I have rarely detected ice in the canal. The communications of this lymph-space have already been described.

Canal of Petit.

The vitreous very closely resembles fresh white of egg, both in appearance and consistence. If a small circular wound be made in the sclerotic of a healthy eye the vitreous will not pour out, but will protrude as a small glistening button of

* Although the hyaloid membrane is thus described by Klein, Quain, Sharpey, Sappey, and many other authorities, yet other writers of equal repute,—*e.g.*, Iwanoff, Schwalbe, Robin, Henle, &c., deny its existence altogether, and maintain that the vitreous is in immediate contact with the membrana limitans interna of the retina. For the pathological arguments urged against its existence, *vide* Iwanoff in the *Archiv für Ophthalmologie*, vol. xv. part 2, p. 51.

sufficient consistence to be snipped off with a pair of scissors. Minute lymph clefts, arranged in a concentric manner towards the periphery, and in a radiating manner towards the centre, can readily be made out by staining the surface of the vitreous with a colouring fluid in a fresh eye divided through the centre. Round, fusiform and stellate cells, with long branched processes, also exist throughout the vitreous, especially towards its surface. They undergo amœboid movements. A minute canal—the canal of Stilling—lined by a thin involution of the hyaloid membrane, extends from the optic papilla to the back of the lens capsule.

The Lens.

*The Lens.*—The lens is entirely surrounded by a smooth, almost structureless capsule. The front portion of the capsule is as thick again as the posterior part. It is thinnest of all at the posterior pole. The capsule is materially strengthened by the suspensory ligament of Zinn, which, after leaving the ciliary processes, splits up into a number of brush-like fibres to be inserted into the anterior, and partly into the posterior capsule of the lens, close to its periphery, in a peculiar zigzag fashion (Brailey.) The capsule when torn *in situ* is very elastic, and rapidly contracts and puckers up. The posterior surface of the anterior capsule is lined throughout by a single layer of columnar cells with an hexagonal base, the latter part resting against the capsule. These cells are perfectly transparent and homogeneous; but after death the cells become cloudy, and a reticulated nucleus and stroma can be demonstrated. At the lateral margin of the lens these cells rapidly elongate, and from being vertical incline more and more obliquely on each other, and as they are traced backwards, they become tapered and arch over their predecessors, their distal extremities being in regular succession against the inner ends of the columnar cells mentioned above. As each cell is longer than its neighbour, and the fibres taper rapidly towards the corner of the arch, the fibres appear to run parallel in a horizontal section through the lens. The lens fibres then are nothing more or less than enormously elongated ribbon-shaped cells "passing from the posterior surface to the anterior, the posterior extremities being in contact with the posterior capsule, the

anterior with the epithelium of the anterior capsule" (Klein). Between the two surfaces of the lens the fibres are arranged in concentric lamellæ. The fibres are narrow and hexagonal in section, and as they all lie in close contact, a section through the lens parallel to its surface shows a beautiful mosaic. These hexagons are remarkably uniform in shape, and are arranged very evenly; but here and there a fibre fails to fill the area allotted to it, so that a space exists between the contiguous fibres. These spaces are said to be lymph channels, and are intimately connected with the nutrition of the lens and with the changes in accommodation. We have been describing the lens fibres as they would be seen on a flat surface, but as the lens is made up of such planes, the approximation of the ends of successive pairs of such fibres in regular order will give rise, from a bird's-eye view, to more or less stellate arrangement, the number of rays varying with the number of such collections of fibres. These rays or sutures can frequently be seen by means of the oblique light in a healthy eye. In the child each surface presents three such sutures, arranged as a Y in front and as a ⅄ behind, each pair enclosing one-third of the circumference. In the adult there are secondary rays in between. These sutures contain a semi-fluid homogeneous cement substance similar to that between the fibres themselves. It is along these sutures that those degenerative changes are most prone to commence which constitute cataract.

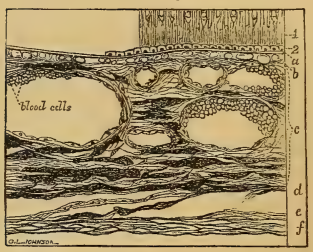
*The Tunica Vasculosa.*—The choroid and iris, from the continuity of their bloodvessels and similarity in structure, have together received the name of the Tunica Vasculosa. Tunica Vasculosa.

The choroid is a highly vascular membrane of variable thickness. It is firmly attached to the sclerotic by means of numerous vessels and nerves, which pierce the sclerotic to enter it. At its commencement, around the entrance of the optic nerve, the stroma of the choroid is continuous with the fibres of the lamina cribrosa. A slight force will detach the retina from the internal surface of the choroid, though the pigmental epithelial layer of the retina generally remains adherent, thus leaving the ends of the rods and cones free; indeed, it was this fact that led to the

epithelial layer being considered a portion of the choroid. At the ora serrata the inner surface of the choroid becomes thrown into a series of folds separated by deep grooves. These are the ciliary processes. They are about seventy in number, of very irregular outline, and rest on a stroma of connective-tissue fibres directly continuous with the tissue of the ligamentum pectinatum and iris. They are covered with a very thick stratum of jet-black pigment cells, on the inner surface of which rests the pars ciliaris retinæ and the hyaloid membrane. The anterior part of the choroid, commencing from the ora serrata, together with the ciliary processes and the ciliary muscle, are collectively termed the *ciliary body*, and the space included by these parts, together with the corresponding strip of sclerotic on its outer side, is known as the *ciliary region*.

Ciliary body

FIG. 7.




Section of the Choroid and External Layers of the Retina, from a preparation of the author's. Magnified 100 times.

1. Layer of rods and cones.
2. Pigmentary layer of retina.
*a*. Lamina vitrea.
*b*. Membrana chorio-capillaris.
*c*. Lamina vorticosa.
*d*. Lamina supra-choroidea.
*e*. Lamina fusca.
*f*. A portion of the sclerotic.

THE CHOROID.

*The Choroid* (Fig. 7) is made up of the following layers from without inwards:

1. The Lamina Fusca.—A loose connective-tissue layer, containing pigmented branched cells and lymph spaces, and covered with an endothelial lining. This layer adheres to the sclerotic after the choroid is removed.

2. The Lamina Supra-choroidea, identical in substance with the above, and forming its opposite wall. In the meshes of the fibres, between the two, is the peri-choroidal lymph space.

3. The Tunica Vasculosa.—This layer forms the bulk of the choroid, and is made up of a loose layer of connective-tissue cells surrounding the large vessels, so that a section resembles a row of large tubes held together by a scanty network of fibres.

4. The Chorio-capillaris (Tunica Ruyschiana).—This is a special layer of branched spindle-shaped and flattened cells, pigmented and unpigmented. They contain a dense network of capillaries. Between these two layers Klein describes another, the elastic layer of Sattler, consisting of two endothelial layers, with a stratum of elastic fibres in between.

5. Lastly, the Lamina Vitrea (Membrane of Bruch).—This is a nearly structureless hyaline lamina, identical in breadth and appearance with the membrana limitans interna of the retina. Against this rests the pigmentary epithelial layer of the retina. The chorio-capillaris and lamina vitrea are the seat of several very important pathological changes, especially in connection with plastic effusions. Lamina vitrea.

*The Ciliary Muscle* forms a circular band of unstriped muscular fibres wedged in between the sclerotic and ciliary processes, immediately behind the root of the iris and ligamentum pectinatum. The greater part of the muscle is composed of meridionally-running bundles of fibres, which arise from the cornea and sclerotic, near their junction, just internal to Schlemm's canal, and the fibres spread out inwards and backwards in a fan-shaped manner, to be inserted into the stroma of the ciliary processes—a few fibres passing round the angle into the iris itself. The remaining portion—the fibres of Müller—consist of numerous bundles of fibres, which encircle the lens at the root of the iris. They run in a plane, at right angles to the former fibres. Ciliary muscle.

*The Iris*.—The iris is a framework of muscular and connective tissues, containing a rich network of pigment-cells, vessels and nerves. From before backwards we find the following layers. 1. The endothelial layer, with (2) its delicate hyaline membrane, the continuation of the remnant of Descemet's membrane. 3. The substantia propria, which consists of bundles of connective tissue, holding in its meshes the vessels and nerves and numerous branched pigment-cells. 4. A hyaline layer, continuous with the lamina vitrea of the ciliary processes and choroid. 5. The "uvea," a prolongation of the pigmentary layer of the retina and ciliary processes, and similar to it in struc- The Iris.

The Iris.

ture. In blue irides this is the only layer that contains pigment granules.

It will be seen from the above description that the choroid, ciliary processes, and iris, not only closely resemble one another in structure, but their inner layers (viz., the substantia propria, hyaloid, and pigmentary membranes) may be traced without solution of continuity from the optic nerve to the margin of the pupil.

The arteries of the iris are remarkable for the thickness of their walls, especially their outer and middle coats. They spring from a vascular ring formed by the anastomoses of the long and anterior ciliary arteries round the base of the iris (circulus major), and pass forwards in a tortuous manner in the middle of the stroma to form a second circle of anastomosis at the pupillary margin. Here they communicate with the veins by means of a very fine capillary plexus. The veins follow the arterial branches. Lymphatic sinuses exist in the sheaths of the bloodvessels and between the trabeculæ of the connective-tissue bundles. They open into the spaces of Fontana.

The muscular fibres of the iris are situated in the stroma. The sphincter consists, like the dilator, of unstriped fibres. The dilator is developed from the fasciculi of the sphincter by a series of overlapping arched fibres. As the fibres pass to the circumference they divide, to form two layers, a superficial coarse layer and a deeper fine layer. At the ciliary border they form by their interlacement a narrow circular plexus of fibres.*

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* Most textbooks describe the radiating fibres as running in straight lines to the sphincter, but this is evidently a mistake. If a living healthy eye be examined with a magnifying glass, the deep layer of fibres will all be seen to have a wavy outline ~~~~~~~~~~, while the thicker superficial ones will be seen to divide dichotomously, the two branches uniting in a similar way to form a fibre like the original one, thus resembling two Y's joined end to end ( ). Of course there are endless modifications of this shape; but whatever their shape, wavy, curved or branched, they all appear to serve one purpose—viz., to allow of the pupil becoming contracted without in the least stretching

*The Retina.*—The retina consists of nerve-fibres and cells, arranged in well-defined, sharply demarcated layers, running parallel to the surface and supported by a remarkable framework of connective tissue, the fibres of Müller. From without inwards, the following layers are recognized :—1. The pigmented epithelium. This forms a single layer of nucleated polygonal cells, forming an hexagonal mosaic pavement on the surface of the lamina vitrea. The inner portion of each cell is prolonged into a brush of densely pigmented processes, in which the rods are embedded. The outer part of the cells have little or no pigment. 2. The layer of rods and cones. 3. The limitans externa. 4. The outer nuclear. 5. The outer molecular. 5. The inner nuclear. 7. The inner molecular. 8. The ganglion layer. 9. The layer of nerve-fibres; and lastly, 10. the membrana limitans interna. The nuclear layers are recognized at once by their large cells and deep staining. The molecular layers are known by their fine granular appearance and inaction to logwood or carmine. The ganglion cells and nerve-fibres in their respective layers require special methods of treatment to bear the least resemblance to pictures of them in modern text-books.

THE RETINA.

Hexagonal cells of.

In the axis of the eye, $\frac{1}{10}$in. to the outer side of the disc, is the macula lutea, or yellow spot. It is pink in health, the yellow appearance being due to post-mortem changes. The large bloodvessels of the retina pass above and below, but never across the yellow spot. Minute vessels pass directly to

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the fibres. If one bears in mind the immense number of radiating fibres round the iris, and the minute size and delicacy of the sphincter, it becomes incredible, were all the radiating fibres to be put on the stretch (which the received account renders inevitable) that the sphincter could possibly overcome such a resistance. I have repeatedly examined irides made to contract under eserine, and other stimuli, and have invariably observed the wavy fibres straighten out and the lozenge-spaces to elongate by the approximation of their sides, in the same way that ornamental wickerwork frames are adapted to fit different sized vases.—G. L. J.

Vessels of Retina.

it from the papilla, terminating at the border of the fovea by means of capillary loops, so that this last is quite destitute of vessels. The retinal vessels are surrounded by peri-vascular lymph spaces similar to those of the iris. The large arteries and veins are all situated in the nerve-fibre layer of the retina, the other layers, as far as the inner granular layer, being supplied by minute loops from the arteries. The external granular layer and the rods and cones are, like the fovea centralis, destitute of vessels.*

Where the optic nerve perforates the lamina cribrosa all the nerve-fibres lose their medullary sheaths, and the delicate axis cylinders, which alone remain, pass round the margin of the shallow optic depression and form the internal layer of the retina.

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* Of late years a fresh impulse has been given to the study of the retina, through the discovery of the visual purple (*Sehpurpur*) by Boll. He found that the outer part of the rods (which lie between the brush-fibres) become stained when kept away from the light, giving the retina, a purple-pink colour. This gradually fades away on exposure, a pale grey being left. Kühne, taking advantage of this fact, made use of the eye as a photographic apparatus. By keeping a rabbit in the dark for some hours and then exposing its eye to daylight let into a dark room through a tube, he was enabled to take a negative on the retina of a design placed in the lumen of the tube. After an exposure for some seconds and subsequent removal of the retina, the design appeared in pink on a white ground, though entirely destitute of details or alternations of light and shade. This purple can be isolated, and restored when faded by contact with the pigmented epithelium. "Retinas of eyes kept in the dark, red, or yellow light, easily separate from the pigmented epithelium, owing to an active retraction of the pigmented fibrils mentioned above." (Kühne, *Untersuchungen a. d. phys. Institut d. Univ. Heidelberg*, vol. ii. 1879, and vol. iii. 1 and 2, 1880).

## ACCOMMODATION OF THE EYE.

ACCOMMODATION OF THE EYE. Due to changes of curvature in the lens.

It appears that in the accommodation of the eye for near objects the convexity of the anterior surface of the lens is increased. It is evident that this, or some equivalent change in the dioptric media of the eye, must take place, otherwise rays of light from a near object (divergent rays) could not be brought to the same focus as rays from distant objects (parallel rays); in other words, parallel and divergent rays cannot be focussed on the retina unless the medium through which they pass is capable of altering its power of refraction. (*See* Chapter on "Errors of Refraction.")

The experiments of Helmholtz.

Helmholtz, in his experiments, took advantage of the well-known fact that when a lighted candle is held in front of a healthy eye, three reflected images of the flame may be seen apparently in the pupil—an anterior and posterior erect image, being the reflections from the cornea and anterior surface of the lens, and a middle but inverted image reflected from the posterior surface of the lens or vitreous. With his ophthalmometer he was able to measure the magnitude of these reflected images under varying circumstances, and he found that so long as the person under observation looked steadily at a distant object—that is, accommodated his eye for the far point—the three reflected figures of the flame of the candle remained unaltered in size; but the instant the accommodation of the eye was changed, and a near object was brought under observation, the reflected image from the anterior surface of the lens increased in magnitude, the other figures remaining unaltered in size.

Changes of curvature demonstrated.

It became evident, therefore, that in varying the accommodation of the eye from a far to a near object, the convexity of the anterior surface of the lens was augmented, the depth of the lens from before backwards being increased by the bulging forwards of its anterior surface. The increase thus observed in the curvature of the lens, has been shown, mathematically, to be sufficient to bring divergent rays from near objects to the same focus as that of parallel rays from distant objects without such alteration. In the latter case the lens is at rest, and it is only when we look at near objects that the accommodation is brought into play.

Accommodation a voluntary act.

The accommodation of the eye appears to be a voluntary act, inasmuch as it is under the control of the will: we wish to see a near object, and on looking at it, the changes in the form of the lens above described take place, in the same way as the extensor muscles respond to the desire to open our hand when closed. In the infant we see how vague and uncertain the performance of those actions is, which for accuracy depend upon the accommodation of the eye; doubtless by repetition these actions afterwards become unconscious and automatic; the acquired faculties being organized in the constitution of the sensori-motor ganglionic nuclei, the movements follow as reflex effects of an external stimulus. Another point especially deserving attention in connection with these focal adjustments, is the combined precision and incessant variation required; so long as a person is awake, alterations in the distance between the retina and objects under observation must be taking place at every instant, necessitating corresponding alterations in the curvature of the lens; for it has been proved that, for correct vision, not only must the rays of light be brought to a focus on the retina but accurately focussed on its bacillary layer.

Focal adjustments.

Attributed to the ciliary muscle.

The accommodation of the eye is effected by the action of the ciliary muscle. In support of this idea we cannot overlook the fact that in animals whose range of accommodation is highest, as birds, the ciliary muscle is largely developed; in those, as fishes, in which accommodation is almost *nil*, the ciliary muscle is hardly developed. At one time it was supposed, that in the accommodation of the eye the action of the ciliary muscle was much assisted by the iris; but Von Graefe's case has settled this point; for, in this instance, the whole of the iris was removed and yet the power of accommodation remained perfect. On the other hand, if the action of the ciliary muscle is paralyzed by atropine, the accommodation of the eye is destroyed, and consequently all objects held close to it are blurred and dim.

## CHAPTER II.

*Methods employed in examining the Eye and Lachrymal Apparatus—Tension of Eyeball—Tests for Colour Blindness—Test Types—Visual Field—The Ophthalmoscope: its Principle and Use—Ophthalmoscopic Appearances of the Healthy Eye.*

### EXAMINATION OF THE EYE.

Examination of the Eye.

THE essential point to attend to in examining the eye is, that it should be illuminated by a clear, bright light. The patient may conveniently be seated before a window, the surgeon standing in such a position, that no part of his person intercepts the rays of light from falling directly on the patient's eye, and yet enabling him to examine the part thoroughly.

Light.

Manipulation.

The next thing to be done is to open the eyelids, the upper one with the thumb of one hand, and the lower with the other. This manipulation, though simple enough, requires care; even slight pressure on a diseased eyeball frequently causing pain and irritation, followed by a gush of tears from the eye, which for the moment prevents us from proceeding with our examination. The lids having been separated as far as possible, the condition of the cilia, puncta, conjunctiva, sclerotic, cornea, and iris should be carefully noticed.

The two eyes to be compared.

If one eye only is diseased we must compare its condition with the sound eye; slight alterations in the colour and brightness of the iris, which may nevertheless be very significant, are often thus distinguishable, and any abnormal prominence or flattening of one cornea will be made more apparent by contrast with the other. It is, moreover, by a comparative examination of this kind, that we ascertain the nature of the various derangements that are met with in connection with the muscular apparatus and movements of the eyeball.

Activity of the pupil.

*Examination of the Iris.*—It will frequently be necessary in examining the diseased eye, to ascertain if the iris responds to the stimulus of light, or, in other words, if the pupil dilates and contracts freely. To determine this, the patient should be placed before a moderately strong light, which falls obliquely, from one side only, on the eye. The unaffected eye should be closed with a folded cloth or the hand. The surgeon alternately closes and uncovers the affected eye with his hand, keeping the pupil well in view. If the iris is healthy the pupils will have dilated while the light was shaded from the eye, but will contract again the instant that bright luminous rays reach the retina. Any deviations from this rule should be carefully noticed, for, in the absence of synechia or other mechanical impediment to the motions of the iris, the character of its response to luminous impressions afford us valuable information in many disorders affecting the deep-seated structure of the eye. The retina of one eye may, however, be diseased and yet the pupil dilates and contracts on the stimulus of light, for light falling on the retina of a healthy eye will through reflex action cause the contraction of the iris in the other eye, although it be amaurotic; and, on the other hand, an inactive and dilated pupil does not invariably indicate a diseased condition of the retina. In all doubtful cases apply a weak solution of atropine to the eye; the existence of synechia are demonstrated in this way, the affected pupil dilating in an irregular manner. But supposing there are no such complications, the atropine will nevertheless be useful, enabling us the better to examine the deeper structures of the eye with the ophthalmoscope.

Value of its indications.

Use of atropine.

Examination of the lids.

*Eyelids and Lachrymal Apparatus.*—It is by no means an uncommon circumstance for foreign bodies to become lodged beneath the upper lid, and in order to see them it is necessary to evert the lid. A steel probe, or some such instrument which will not easily bend, is laid against the skin of the lid along the upper border of the tarsal cartilage, or about half an inch from the free margin of the lid; the surgeon, with the other hand, takes hold of some of the most prominent cilia, and after gently drawing the lid forward, turns it backwards over the probe; if

Mode of everting them.

the patient is now directed to look downwards, the superior palpebral conjunctiva may be examined.

Lachrymal obstructions.

The condition of the passages by which the lachrymal secretion passes from the eye into the nose often requires investigation, for should they become occluded, it is evident that the tears will be unable to escape through their proper channel, and accumulating at the inner corner of the eye will overflow and run down the cheek. Under these circumstances an idea may be gained of the seat of the obstruction from the following considerations :—If the puncta and canaliculi are healthy, gentle pressure made over the lachrymal sac will cause a minute drop of fluid to ooze out through the puncta ; but supposing these structures to be impervious, no such regurgitation of fluid can take place. If therefore constant lachrymation exists, and on making pressure below the tendon of the orbicularis, a drop of fluid oozes out through the puncta, we may conclude that the obstruction is in the nasal duct.

Situation ascertained.

Displacement of the puncta.

There are, however, exceptions to this rule, for if the lachrymation depends on malposition of the puncta, either from chronic inflammation and thickening of the conjunctiva, from paralysis of the orbicularis, or any other cause slightly displacing the puncta, it is evident that only a portion of the tears can gain access to the sac, the remainder flowing over the cheek. Under these circumstances, the lachrymal sac being partly full, if pressure is made over it, a drop of fluid will ooze out through the puncta ; but in such cases there can be no difficulty in ascertaining the cause of the overflow, the displacement of the puncta being readily seen.

Exploration by probe.

If we have reason to suppose that either the puncta or canaliculi are closed, we may explore the parts by introducing a fine probe into the punctum, and passing it along the canaliculus into the lachrymal sac. In this operation the lid should be slightly everted, so as to expose the punctum, and a fine probe should be passed into it for about half a line in a perpendicular direction, the instrument being afterwards directed horizontally inwards towards the lachrymal sac. Some slight resistance to the passage of the probe is often felt at one or both extremities of the canaliculus ; this arises from the presence of two small valves,

Caution required.

and the involuntary contraction of the sphincter muscle which surrounds the orifices of the duct. Gentle, but continued pressure with the probe, in the direction above indicated, will speedily overcome the spasm of these contractile fibres, and the instrument will then readily enter the sac, and its point may be pushed against the inner bony wall.

Tension of the eyeball.

*Tension of the Eyeball.*—The patient should be directed to close the lids of the eye under examination; the surgeon then places the tip of one forefinger on the outer part of the eyeball, exerting gentle pressure on the opposite side of the globe with the forefinger of the other hand; the amount of resistance offered indicates the degree of tension. In its healthy state the globe can be easily dimpled, but in chronic glaucoma it becomes of stony hardness; and for convenience of note taking, we may divide the degrees of tension of the eyeball into "normal tension," tension increased slightly (+1), rather more (+2), of stony hardness (+3). The normal tension of the eyeball, however, has a certain range or variety in persons of different ages, build and temperament, and according to varying temporary states of the system, as regards emptiness and repletion.

Defects in colour-sight.

*Defects in Colour-sight.*—The easiest method of detecting defects in colour-sight is by the use of Holmgren's test.* This consists of bundles of coloured wools, skeins of various tints of red, orange, yellow, yellow-green, pure green, blue-green, blue, violet, purple, pink, brown and grey. The patient is supplied with a sample of wool, and directed to match it with a skein of exactly similar tint in the bundle of various coloured wools; if he can do this quickly, and without making any mistakes, especially with the scarlet and green tints, his colour-sight is good. On the other hand, supposing we give this individual a light shade of green, and he fails to match it with a precisely similar shade of green, but selects from the skeins of wool a shade of grey as a match to the light green, he is colour-blind.

We next supply the patient with a skein of wool midway in

* Worsteds, matching as nearly as possible those of Professor Holmgren, may be had of Messrs. Pickard & Curry, 195, Great Portland Street.

colour between the lightest and darkest shade of red-mauve; supposing he matches this with a blue or violet colour he is red-blind. If he matches it with a grey, he is green-blind. Further, if red-blind, he will match a scarlet skein with a dark green or brown wool. But if green-blind, he will choose a light green or brown to match a skein of scarlet wool.

Test types.

*Test Types.*—It is advantageous to have a fixed scale by which to test the acuteness of vision, and which may be used not only as a standard of comparison between one person and another, but also to ascertain whether a patient's sight be improving or otherwise under treatment. Cowell's test types are most convenient for this purpose.* A series of these types from No. I. to No. XL. are arranged according to the size of the letters, so that No. I. is seen by an emmetropic eye at a distance of one foot at an angle of five minutes, and its letters cannot be distinctly made out beyond that distance. The letters No. II. are seen at two feet distance at the same angle, and so on.

Cowell's types.

Method of using them.

Supposing now a patient to be affected with a defect of vision, so that he cannot seen No. I. type at a distance of twelve inches from his eyes, but can make out No. IV. type at this distance; evidently he requires to see the letters under a larger angle than that of five minutes, in order that he may gain a larger retinal image. We calculate the degree of acuteness of vision as follows :—Let

V = Acuteness of vision.

d = utmost distance at which the type is recognized.

D = distance at which type appears at an angle of five minutes.

$$\text{Then } V = \frac{d}{D}.$$

For instance, the individual who, having his eyes properly accommodated, distinguishes No. XX. test type at ten feet instead of twenty feet, has diminished acuteness of vision,

$$V = \tfrac{10}{20} = \tfrac{1}{2}.$$

If he can only distinguish No. III. type at one foot, his acuteness of vision $V = \frac{1}{3}$, and so on.

* Messrs. Harrison & Sons, Printers, St. Martin's Lane.

Range of accommodation.

The range of accommodation for vision at different distances varies in different individuals and at different periods of life ; in the normal or emmetropic eye, the nearest point of distinct vision is from three and a half to four inches, and the furthest point is at an infinite distance, being limited only by the loss of the rays of light, due to atmospherical or physical causes.

Visual field.

*The Visual Field.*—The visual powers may be almost perfect at the macula lutea, and yet beyond this spot the functions of the retina may be completely destroyed. It is often necessary, therefore, to ascertain the extent of the visual field—that is, of the integrity or otherwise of the whole of the sentient surface of the retina.

Limits ascertained.

The limitation of the visual field may be ascertained in the following manner. The patient is seated at a distance of a foot from a blackboard, or a frame in which has been placed a sheet of blue tissue or other paper. On the centre of this a small cross is marked with chalk or pencil, and the patient is directed to fix his eye upon this point, the other eye being closed. The crayon is now moved over the paper, being carried successively upwards, downwards, and to the right and left horizontally, marking in each direction the extreme limits at which the patient perceives it. The same plan is followed for all intermediate points, and the outline thus drawn upon the board or paper shows the limit of the field of visual perception. The other eye may then be tested in the same way.*

A good idea of the extent of the visual field may be obtained by directing the patient to close one eye, and with the other to look steadily at one of the observer's eyes. While the patient keeps his eye fixed in this way, the observer moves one of his fingers in various directions over the patient's field of vision, ascertaining how far the finger can be seen from the optic axis of the eye under observation. It is evident that under these circumstances, if the functions of any part of the retina external to the macula lutea is impaired, that the patient will be unable

* "The Diagnosis and Treatment of the Diseases of the Eye," by Dr. H. Williams, Harvard University, U.S.

to see the observer's fingers when situated at the corresponding part of the visual field.

If the patient's sight is so far impaired, as for instance by an opaque lens, that he can no longer count fingers, it may yet be necessary to test the extent of vision, which may be managed as follows. One eye being closed, we direct the patient to fix a luminous point while we throw on the eye, by means of a small mirror, the light of a lamp. By varying the position of the mirror we can give to the light all directions, and thus examine the perception of light through the entire extent of the retina. If the perception of light is preserved in all directions we know there is no detachment of the retina. Another method.

## THE OPHTHALMOSCOPE.

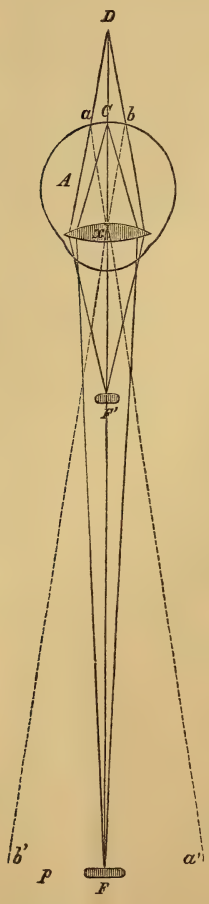
*Illumination of the Eye.*—The reason why we cannot ordinarily see the interior of the eye without the aid of an ophthalmoscope, as well as the principle of its action, will become intelligible by reference to the following figure (Fig. 8), in which A represents the eye under examination, accommodated to the distant point F, where the flame of a lamp is supposed to be situated. It is evident that some of the divergent rays, proceeding from the luminous body at F, will fall upon A's cornea, and being refracted by its dioptric media, will meet at C on A's retina. Some of these rays are absorbed, others are reflected by the structures of the fundus, and these, before emerging from the eye, must pass through precisely the same media as they did on entering it; and in consequence of their pursuing this path, they will be brought to a focus at the point from which they started—namely, at F. Unless an observer's eye, therefore, can be made to take the place of the luminous body at F, it is evident that none of the reflected light from A's retina can possibly reach the observer's. A's pupil, therefore, appears black to a person in the position *p*, or, in fact, at any other point than at F.* If, however, a mirror with a hole in its centre, THE OPHTHALMOSCOPE. Its principle. Why the pupil appears black.

* "Manual of Instructions for the Guidance of Army Surgeons in Testing the Range and Quality of Vision." By Deputy Inspector-General J. Longmore, Professor of Military Surgery at the Army Medical School. Page 38.

Illumination by a perforated mirror.

through which light can pass, be substituted for the lamp, and the rays reflected from its surface be directed into the eye A, the light returning from A's retina can now enter the observer's eye, which, under these circumstances, may be made to occupy the position of the lamp, as represented in Fig. 8.

FIG. 8.




Again, suppose the luminous body is removed from the point F to F′ (the patient's eye being still accommodated for the distance A F), the divergent rays proceeding from it, and being refracted by the dioptric media of A, would intersect at D, were they not intercepted by the fundus of the eye; as it is, they form a circle of light extending from *a* to *b*. But since the eye A is adjusted for the far point F, and not for F′, it follows, that the rays reflected from any point in the circle *a b*, after emerging again from A, will be brought to a focus at the distance A F; and those from the extreme points *a* and *b* will converge respectively to *a′* and *b′* in lines prolonged from *a* and *b* through *x* the optical centre of A. Under these circumstances, an observer's eye at any point *p* will receive a few of the rays from A's retina, which will thus appear illuminated, even without the aid of a mirror.

If these considerations be applied to the ophthalmoscope, the principles upon which this instrument depends as a means of illumination may be readily comprehended, it being essentially a mirror, constructed so as to allow the observer's eye to take the place of the flame of the lamp, as represented in Fig. 8. As, however, the deeper parts of the eye are only seen through its refracting media, we have still to

explain the formation of images of those parts, which may be distinctly visible to the observer.

*Formation of Images.*—There are two distinct modes of examining an eye with the ophthalmoscope, known as the direct and the indirect methods. By the former an erect real image is perceived by the observer, and by the latter an inverted aerial image is produced. Formation of images.

1. By referring to Fig. 9 the *direct method of examination* may be readily understood. A represents the eye of the observer and B that of the patient, F the source of light, from which a cone of rays *a b* falls upon L, a double-convex lens interposed between F and the plane polished surface *c d* of the ophthalmoscope S. By means of the lens L the divergent rays of light from F are made to converge upon the mirror (which thus acts as a concave mirror in a position posterior to the eye of the observer), and after reflection from its surface, they proceed as if they came from *a' b'* situated behind it, and converge towards some point *p*. A portion, however, of the rays included between *g i* and *h k* is intercepted by the dioptric media of B, and these, after refraction, intersect at O within the eye, from whence they again diverge to form a circle of light upon B's retina. If in this circle any two points *α*, *β*, be taken, the reflected rays from which pass through the sight-hole *m n* of the ophthalmoscope, they will be brought to a focus at *α' β'* on A's retina, and a virtual, erect, and magnified image *α'' β''* of *α β* will be seen by the observer, apparently projected beyond the patient's eye.* 1. Direct method. Image erect, magnified.

In the *indirect* method of ophthalmoscopic examination, it is necessary to place a convex lens in front of the patient's eye. In Fig. 10, A represents the observer's eye, B that of the patient, F the source of light, L' a convex lens, by which a cone of converging rays is made to fall on the mirror S, and which, being reflected from its surface, *c d*, would find a focus at some point *o*; but by the interposition of a second convex lens, L'' (object lens), the rays are brought to an earlier focus at *p*, whence, after intersection, they diverge until intercepted by *g h*, the cornea of B. 2. Indirect method. Using a convex lens.

* The eyes of both observer and patient are supposed to be emmetropic.

A portion of this light, corresponding to the aperture of the pupil *i k*, enters the eye, and rendered slightly convergent by its dioptric media, proceeds to form a circle of light *m n* on the retina. The rays, returning from any two points *α* and *β* in this circle will emerge parallel, or slightly convergent from B (according to its accommodation), and after refraction by the object lens L″, will be united at *α′* and *β′* respectively, at the distance, approximately, from L″ of *q* its principal focus. A real, inverted, and magnified image *α′ β′* of *α β*, will thus be formed; and this will be distinctly visible by A at a distance of twelve or fourteen inches, the rays diverging from *α′* being brought to a focus on the retina at *α″*, and those from *β* at *β″*.

FIG. 9.

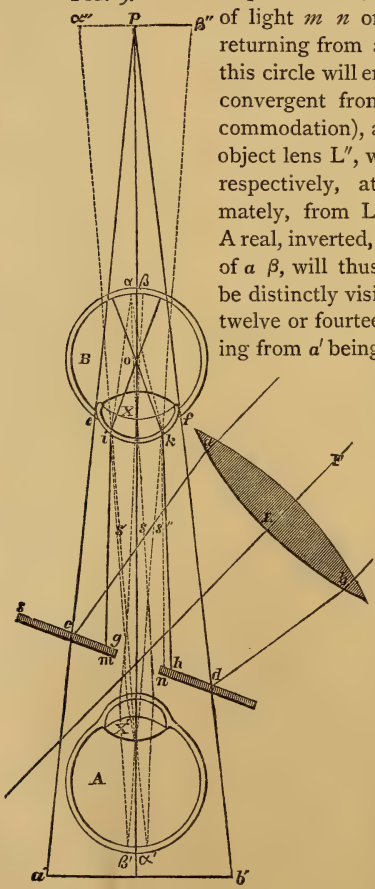



Image inverted.

Indirect method.

*The Indirect Method* of examination enables us to obtain a clear, inverted image, of the details of the fundus at about fourteen inches from the eye under observation. If the pupil is dilated we can thus at a glance see the optic disc and surrounding structures. The indirect method, therefore, is very useful, in that it gives us a general view of the fundus, and so enables us readily to detect any abnormalities.

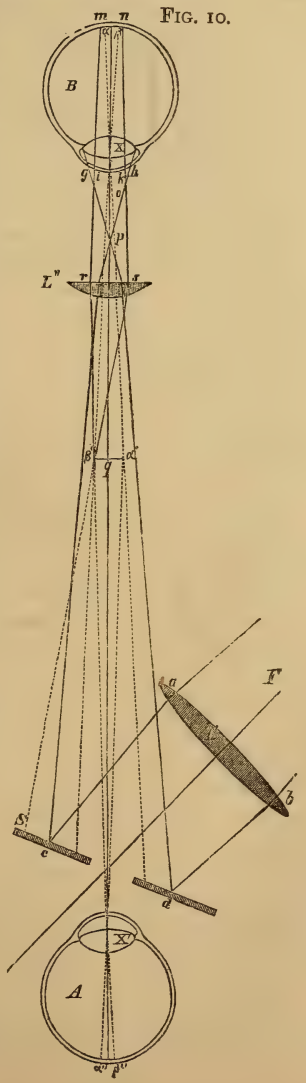
Direct method.

*The Direct Method* of examination, however, enables us to appreciate far more exactly than the indirect method, the nature

of actual or suspected alterations in the condition of the fundus of the eye. By this method, supposing the eye under observation is emmetropic (refraction normal), at a distance of three or four nches from the eye we perceive an erect and enlarged image of a definite portion of the fundus. The image is often so much enlarged that we cannot see the whole of the papilla in the field of the pupil; it may be that even the trunk of one of the vessels is sufficient to fill it. If the patient under observation is myopic it will be necessary to place a concave lens behind the mirror of the ophthalmoscope of sufficient strength to give us a clear erect image of the fundus. The erect method is also very useful in detecting opacities in the vitreous or lens, and detachments of the retina. Lastly, by the direct method the ophthalmoscope may be employed to ascertain the refraction of the eye, a subject I shall return to when considering hypermetropia and other errors of refraction.

*Choice of an Ophthalmoscope.*—The instrument I prefer to any other is Dr. Loring's, of New York; its price, however, about £7, is a serious objection to its general use. Messrs. Picard & Currie, of 195, Great Portland

FIG. 10.




Choice of ophthalmoscope.

Street, have, at my request, modified Loring's instrument, and I can safely recommend their "Westminster Ophthalmoscope."* But Couper's, Purves's, and De Wecker's ophthalmoscopes are admirably adapted for examining the fundus of the eye and for estimating the kind and amount of any existing errors of refraction.

Source of light.

Having made choice of an ophthalmoscope, our next inquiry must be as to the source of light most readily available, and best suited for ophthalmoscopic purposes.

In places where gas is available, a round full flame from a gas lamp, will probably afford the best source from which to obtain light to throw into the eye for ophthalmoscopic purposes; but in many instances we cannot procure light from a gas-burner, and under these circumstances a kerosene lamp may be used with advantage; it gives a remarkably good light; the flame is steady, white, and clear, and the wick seldom requires to be trimmed.

Atropine not essential.

It is not always necessary to dilate the pupil with atropine before making an ophthalmoscopic examination; a general idea of the fundus of the eye may be gained without the use of any mydriatic; in fact, after some practice it matters little what the position of the patient, the source of illumination or the instrument we use—there is no difficulty in seeing the fundus of the eye; but with beginners it is very different, and the following directions must be attended to. The patient should be desired to look attentively at a mark on the opposite wall of the room, so that his eye may be accommodated for a distant point; if now he close one eye, the pupil of the other will dilate sufficiently to allow of an ophthalmoscopic examination. Should it be found necessary to make a more perfect observation, a gelatine disc or a solution of homatropin may be applied to the eye.

A weak solution to be used.

The two eyes to be compared.

It may be well to remind the reader thatexcept in cases where one eye only is diseased, and the abnormal conditions are clearly

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* The *Westminster Ophthalmoscope* may be purchased from Messrs. Picard & Currie, for the sum of £2 10*s*.

and unmistakably apparent, a prognosis should not be ventured on until both eyes have been examined, the state of the one being carefully compared with that of the other. Nothing is so likely to damage one's reputation, or to shake the confidence of our patients in our judgment and skill, as giving a hasty or ill-considered opinion, which on a subsequent examination it may be found necessary to alter: for this reason, also, it is advisable to write down the appearances presented by the eye in a note-book, with which to refresh our memory, and enable us to form an idea of the progress of the disease, if at any subsequent period the patient present himself for inspection.

*Examination of the Actual Inverted Image.*—The eye of the surgeon, that of the patient, and the source of light should be upon the same level, the lamp being placed close to, and a little behind the ear of, the latter. The patient is directed to fix the eye under observation so that it is inclined slightly inwards, when the rays of light from the ophthalmoscope will fall directly upon the optic disc.

The inverted image. Position of patient and observer. Fixing the patient's eye.

In using the ophthalmoscope, the sight-hole of the instrument should be applied to whichever of the observer's eyes is most convenient to himself, its rim being made to rest against his eyebrow, and as he turns his head, the instrument will move with it. The object lens in front of the patient's eye, should be held a little obliquely between the thumb and forefinger of the other hand, the ring and middle fingers resting against the patient's forehead, which thus acts as a fixed point, enabling the observer to approximate or withdraw the object lens to or from the patient's eye, so as to bring the retina into focus with the greatest precision, and also to follow the movements of the eye under examination.

Management of the instrument.

The beginner may be troubled by the reflection of the ophthalmoscope from the cornea of the patient. It appears as a brilliant image of the mirror on the surface of the cornea, hiding that part of the retina which is behind it. To get rid of this reflection we must incline the mirror in such a manner that the reflections shall fall to the side of the parts to be examined.

*Examination of the Virtual Erect Image.*—As I have already

The erect image.

explained (p. 33) in this mode of examination, no object glass is required, but the observer has to go inconveniently close to the patient's eye. The lamp must be placed on the side corresponding to the eye under examination. If the right eye be the one under examination, the observer should sit on the right side of the patient, so that his right eye corresponds with the patient's, and *vice versâ* for the left eye. The arrangement of the mirror in the Westminster Ophthalmoscope very much facilitates the examination of the eye by the direct method. The beginner will find more difficulty in gaining a distinct view of the fundus of the eye by this means than by the examination of the actual inverted image; nevertheless, it produces a much larger image, so that the fundus of the eye may thus be studied in detail with great accuracy. In all cases requiring the use of the ophthalmoscope both methods of examination should be employed.

Lateral illumination.

*The Lateral Method of Illumination, or the Examination of the Eye by Transmitted Light.*—For this purpose the observer and patient are seated opposite one another, and the lamp is placed in advance, and to one side of the latter, in order that its rays may be concentrated upon the eye under examination by a convex lens. The eye being illuminated in this way, the observer can magnify any part of the lens, iris, or cornea with a convex glass held in front of the eye.

In examination of cornea, iris and lens.

By this means valuable aid is afforded the surgeon, especially in detecting foreign bodies in the anterior chamber, or in cases of synechia and occlusion of the pupil from false membranes. Nebulæ also, which are difficult to appreciate with the unaided eye, may thus be distinctly defined. In fact, abnormal changes going on in the lens and the structures anterior to it, are frequently best appreciated by the lateral method of examination.

## KERATOSCOPY.

Keratoscopy.

*Keratoscopy* is best explained by placing a convex lens at such a distance from a screen that rays of light passing through the lens from a concave mirror are focussed on the screen. Under these circumstances a small and bright image of the lamp is formed, with a sharply defined and dense surrounding

shadow. If the lens is now brought nearer to, or removed from the screen, the image of the lamp becomes feebler, and the line of demarcation between it and the surrounding shadow is fainter. As the lens is moved to different distances from the screen the variations between the brightness of the image and the surrounding shadow will be evident. At the same time, supposing the concave mirror from which the light is reflected is rotated, the direction of the image and shadow will be seen to move on the screen in a direction opposite to that in which the mirror is rotated. If this principle is applied to the human eye, and light reflected from the surface of a concave mirror (ophthalmoscope) is directed into the eye, on looking through the sight-hole of the instrument we perceive an illuminated area surrounded by a deep shade on the retina. But since the image is seen through the media of the eye, the direction in which the image moves as the mirror is rotated will depend upon the refraction of the eye under examination. In examining an eye in this way it is advisable, though not absolutely necessary, to apply atropine so as to dilate the pupil. The patient's eye should be about four feet from that of the surgeon; the room should be darkened, and the patient's eye shaded by a screen. The observer must correct his own refraction if he is not emmetropic. The mirror of the ophthalmoscope used must be concave, and the light thrown from it on to the patient's eye at an angle of about 10° or 15°.

Method of using ophthalmoscope.

Keratoscopy.

Under these conditions we see a clearly defined image, with a surrounding shadow on the retina of the patient's eye. As the mirror is rotated the image and shadow move in the opposite direction if the eye is hypermetropic, emmetropic, or slightly myopic. But if the image and shadow move in the same direction as the mirror the eye is certainly myopic, to the extent of 1 D.

Dr. Charnley first pointed out the fact that when an eye is under examination as above described, the higher the hypermetropia or myopia the smaller is the image which we obtain of the optic disc, so that in very high degrees, we see not only the white of the disc but also some of the surrounding fundus of the eye. On the other hand, in emmetropia, or low degrees of myopia

and hypermetropia, the disc appears so large that we cannot see the white of it. "With equally rapid rotations of the mirror, then, the light would have to travel much faster over the large image of the latter than the small image of the former condition,"* and so the difference in the rate of movement of the shadow is the test of the amount of the existing error of refraction.

Keratoscopy may assist us in forming a diagnosis in various cases, but is not likely to supersede the more exact methods of testing errors in the refraction of the eye. Its practical application will be described in the chapter devoted to hypermetropia, myopia and astigmatism.

## OPHTHALMOSCOPIC APPEARANCES OF THE HEALTHY EYE.

Colour of the healthy fundus,

*Colour of the Fundus.*—The whole of the interior of the retinal sphere which can be brought into view through the pupil, or the fundus oculi, as it is usually termed, is among all dark races different in colour from that which is present among Europeans. This difference arises from the light being reflected back from the deep brown or black pigment, filling the hexagonal cells of the retina in dark races, and obscuring the vascular structure which is situated behind it. The fundus of the eye therefore appears of a *brownish-grey* colour among these people; whereas in fair Europeans it is of a *crimson orange* hue, the incident light being reflected from the vascular network of the choroid, which is seen through the transparent retina.

varies in different races.

Appearance of the optic disk.

The *optic disk*, or *papilla*, which is the termination of the optic nerve, or the spot at which it expands into the retina, will be found about one-tenth of an inch internal to the axis of the eye; it is the first point which attracts the observer's attention in making an examination with the ophthalmoscope. The shape of the healthy papilla is generally circular, but it frequently appears oval, because the optic

Its form and colour.

* "Refraction of the Eye; its Diagnosis, and the Correction of its Errors, with a Chapter on Keratoscopy," by A. Stanford Morton, M.B., F.R.C.S., p. 31.

nerve and papilla are inserted sideways into the eye, and we see it more or less obliquely, and consequently, it is shortened in its horizontal diameter. In other cases this oval form is due to a real irregularity of the optic nerve, or to an irregularity in the dioptric media, notably in astigmatism. The size of the optic disc, is by no means the same in all cases, and will appear to be augmented or lessened according to the power used to magnify it.

Optic disc.

The colour of the disc is not uniform, its outer part being greyish and mottled. This appearance is caused by the difference in the light reflected from the nerve tubules, which is greyish, and that from the white glistening bands forming the lamina cribrosa. At the point of exit of the retinal vessels the white appearance is very marked, and often presents a little pit or hollow. The inner half of the disc is of a decidedly redder tint than the outer half, because it is more thickly covered by vessels and nerve fibres, and hence there is no reflection from the fibres of the lamina cribrosa in this situation. It is absolutely necessary to become acquainted with the different appearances which may be presented by the healthy optic disc, or these varying conditions may be mistaken for indications of disease; the outer greyish-white tint, the central depressed appearance and whitish hue, together with the inner pinkish half of the disc, are conditions which vary considerably, but are more or less distinctly recognizable in all healthy eyes.

At the point where the lamina cribrosa ceases, the optic nerve is contracted, and the opening in the choroid being narrow, in a certain measure compresses the nerve trunk; for this reason, a sort of double border is often seen around the margin of the optic papilla. Under the choroidal margin is the line, more or less dark, that indicates the border of the opening in the choroid; under the sclerotic margin is a bright crescent or circle, formed by the curving round of the sclerotic fibres, and appearing between the choroidal margin and the fine greyish line that indicates the narrowest part of the nerve itself, and is therefore called the proper nerve-boundary. The latter under normal circumstances is not usually sharply defined. The choroidal rim is always strongly marked, especially at the outer border of

Nerve boundaries.

the disc, where it sometimes has a well-defined deposit of pigment; this must not be mistaken for a diseased condition of the parts.

The retinal vessels;

The point at which the *central artery and vein* of the retina enter the eye through the optic disc is subject to considerable variation. Generally the artery passes through the whitish and depressed centre of the papilla, and, after emerging from the disc, divides dichotomously, its branches ramifying in all directions towards the periphery of the retina; but the central artery may perforate the disc at any other point; not unfrequently one or two larger branches are noticed in the centre of the papilla, while others pass through its circumference, perhaps close up to the scleral margin of the disc.

estimation of their calibre.

The apparent calibre of the vessels will vary with the magnifying power employed in observing them; practice alone will thus enable us to appreciate abnormal changes in the calibre of these vessels. One frequently reads accounts in which the retinal vessels are said to be over-full or empty, as the case may be; but in truth it is most difficult to determine this point.

Arteries double-contoured.

The arteries, as well as their branches, are thinner, lighter in colour, and straighter than the veins, which are darker in colour and more sinuous in their course. The arteries seem to be transparent in their centres; this arises from the difference in the degree of illumination of the prominent centres of the arteries, as contrasted with their sides: from their conformation, it is evident that the sides of a vessel would receive and reflect relatively less light, and therefore appear in shade.

Venous pulsations.

If in the normal eye the central vein be carefully examined, a pulsation may often be noticed in it, which will be rendered more evident on gentle pressure being made on the eyeball. If the compressing force be increased beyond a certain point, the pulsation at once stops, and the veins become almost invisible from the cessation of the flow of blood through them. In the healthy eye no arterial pulse can be seen, but if pressure be made on the eyeball it will become apparent. We noticed this in a marked manner in cases accompanied with considerable intra-ocular pressure, as for instance, in glaucoma.

Mr. Edgar A. Browne remarks : " The following are the main differential points between the appearances presented by the retinal arteries and veins:*—

| ARTERIES. | VEINS. |
|---|---|
| Smaller. | Larger. |
| Bright red, tending to scarlet (approximate). | Dull red, tending to crimson (approximate). |
| Edge and bright central streak, well marked. | Colour more uniform. |
| Course straight. | Course sinuous. |
| Cross over veins. | Cross under arteries. |
| Pulsation very difficult to see. | Pulsation easily seen." |

Appearance of the retina.

*The Retina.*—The retina is so transparent a structure that when examined by the ophthalmoscope the small amount of light reflected from it is lost in the abundant reflection from the bright scarlet background of the choroid ; but in the case of the natives of India and other dark races, the retina may be distinctly recognized as a grey, striated layer, lying over the black hexagonal cells of the retina, and extending from the circumference of the optic disc as far outwards as the ora serrata.

almost transparent.

The macula lutea.

The Macula Lutea will not be recognized until the student has had some practice with the ophthalmoscope. It is situated in the axis of vision, and its position may be found from the fact of the retinal vessels passing above and below it, but not crossing the macula lutea, which appears as a slight depression in the retina, of a reddish-brown tint with oval borders, or as a minute red spot occasionally surrounded by a yellowish ring. In healthy eyes the macula can only be clearly made out in about 25 per cent. of the cases examined, or in about 40 per cent. of the cases which present themselves at the hospitals. The sensitiveness to light of this spot, its dazzling reflex, and its similarity in appearance to the surrounding fundus are the chief reasons which prevent its being clearly seen.

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* "How to Use the Ophthalmoscope," by Edgar A. Browne, Surgeon to the Liverpool Eye and Ear Infirmary.

The appearance of the choroid.

*The Choroid.*—A layer of fine capillary vessels extends immediately behind the lamina vitrea of the choroid, and between these vessels and the sclerotic the venæ vorticosæ and large branching pigmented cells of the choroid are situated (Fig. 7). It follows, in consequence of this arrangement of the vessels, that when examining the eye with the ophthalmoscope, light passing through the transparent media falls on the capillary layer behind the retina (provided the hexagonal cells of the choroid are transparent), and the light which is reflected back to the eye of the observer from this layer of vessels, gives the uniform red colour of the background of the eye in the healthy fair-skinned European. In albinos, or in persons in which there is very little pigment in the choroid, the larger vessels of the venæ vorticosæ may be seen. Evidently, as the vascular and pigmented layers of the choroid line the inner surface of the sclerotic, it is impossible to see this latter structure with the ophthalmoscope, unless, as often happens in consequence of atrophy of the choroid, a portion of its vascular and cellular structures is destroyed, and then the white glistening sclerotic may be seen.

The sclerotic.

The cornea, aqueous, lens, and vitreous, being in the healthy eye perfectly transparent, no light is reflected from them when under examination by the ophthalmoscope, and consequently they are invisible.

Examination of vitreous.

In examining the vitreous, the patient must be made to look in various directions. By this means opacities will be seen to move quickly to and fro if they exist in the vitreous humour, which under these circumstances is generally fluid. The direct method should be employed in making an examination of the vitreous humour, lens, or cornea.

## CHAPTER III.

## DISEASES OF THE ORBIT.

*Injuries of the Orbit—Diseases of the Bones—Inflammation of the Cellular Tissue—Orbital Growths and Tumours—Dislocation of the Globe of the Eye—Extirpation of the Eyeball—Diseases of the Lachrymal Gland.*

### INJURIES OF THE ORBIT.

Fractures and Contusions.

CONTUSIONS AND FRACTURES.—A blow or fall upon the outer ridge of the orbit is usually followed by no other consequences than a "black eye," but it sometimes happens that an injury of this kind causes a fracture of the orbital plate of the frontal bone. In cases of this description there is frequently considerable ecchymosis, which first appears beneath the conjunctiva of the globe of the eye; then beneath the palpebral conjunctiva, and subsequently in the integument of the eyelids.

Search for a foreign body; and remove it.

PENETRATING WOUNDS OF THE ORBIT.—The first point to be ascertained in the case of a punctured or gunshot wound of the orbit is as to the presence of a foreign body in the wound: our finger or probe will be our best guide in arriving at a conclusion on this point, and should we discover a foreign body lodged in the orbit, we must, if necessary, enlarge the external opening to such an extent as to enable us to remove it. Instances are recorded in which a bullet has remained embedded in the orbit for years, apparently without producing any ill effects; but in ninety-nine cases out of a hundred, unless the foreign body

be removed, inflammation, and suppuration of the tissues of the orbit will ensue, and very possibly irreparable damage be done to the eye.

Direction of injury affects prognosis.

The second point to be noticed is the direction which the instrument has taken; if this be towards the brain, the case may be a most serious one, and our prognosis must be correspondingly guarded. The extent of the external injury cannot be relied on as an indication of the severity of the wound; in fact,

External wound no guide.

on a casual examination no contusion may be detected in the skin, the eyelids having been open when the instrument inflicting the wound passed through the orbit and entered the brain. This point is forcibly illustrated by the following case, related by Mr.

Case.

Guthrie :* A boy was struck while at play with an iron wire in the right eye; there was no external wound to be seen, but there was considerable chemosis of the conjunctiva of the upper and inner part of the eyeball. Four days after the accident the patient complained of sickness and pain in the head; this was

Fatal head symptoms.

followed by restless delirium and coma, and on the sixth day after the accident the patient died. On examination, it was found that a piece of the iron wire had passed under the upper lid, and through the posterior part of the orbitar plate of the frontal bone into the anterior lobe of the brain, which was softened and bedewed with matter. This case shows the extreme caution necessary in forming a prognosis under such circumstances.

If for twelve or fourteen days after the accident has occurred, no head symptoms have supervened, we may be hopeful as to the result, but the patient is not safe from ulterior bad consequences for some time afterwards.

Gunshot Wounds.

Gunshot Wounds of the Orbit, in a practical point of view, differ in no respect from punctured wounds, always taking into consideration the occasional unaccountable wanderings which a ball pursues in this, as in other parts of the body. As already directed in the case of other foreign bodies, the presence or not of the bullet in the orbit must first be determined, and then the direction it has taken ascertained; lastly, it is as

* "Commentaries on Surgery," p. 374, 6th edit., 1865.

necessary to remove a ball from this situation as any other substance. We occasionally meet with instances in which a number of small shot have penetrated the conjunctiva, and perhaps, glancing off from the sclerotic, have become imbedded in the cellular tissue of the orbit. In a case of this kind, all the shot that can be extracted without making a deep incision into the cellular tissue, should be removed; the remainder will become encysted, or in time make their way to the surface, and may then be extracted; it is not advisable to search for them in the deeper structures contained within the orbit.

Small shot in orbit.

May be encysted.

## DISEASE OF THE BONES.

INFLAMMATION OF THE PERIOSTEUM of the bones of the orbit may be either acute or chronic, and the symptoms to which it gives rise will accordingly vary in their intensity, and in the rate at which they advance.

PERIOSTITIS OF ORBIT.

Periostitis in this situation most commonly arises from syphilis, either acquired or hereditary; it may result from an injury, or from exposure to cold. The periosteum of the external margin of the orbit is most frequently affected, a swollen, and on pressure, painful spot will be detected; but if the membrane towards the back of the orbital fossa is involved, it is more difficult to ascertain the nature of the disease. The patient usually complains of deep-seated pain in the orbit, which increases towards bedtime; the globe of the eye protrudes more or less from its socket; as the disease advances, the inflammatory action is likely to extend to the cellular tissue of the orbit, terminating in suppuration. In the earlier stages of periostitis so situated, if pressure be made with the point of the finger deeply into the orbit, we may probably detect a particularly painful spot corresponding to the diseased periosteum, and if nocturnal exacerbations of pain are well marked (the patient having had syphilis) we may be certain as to the nature of the malady.

Causes.

Symptoms.

Pain increased on pressure.

Distinguished from cellular inflammation.

It is sometimes difficult to form a diagnosis between acute periostitis of the deeper parts of the orbit and inflammation of

its cellular tissue.* In cases of periostitis, as above remarked, by pressure against the walls of the orbit we may reach one particular spot that is exquisitely painful; or by forcing the eyeball back into the socket, this tender spot may be indicated. Moreover, as the swelling of the periosteum and cellular tissue around it will at first be limited, the eyeball will be protruded in the opposite direction to that in which the inflammation is situated; for instance, if the periosteum in the upper part of the orbit is inflamed, the globe of the eye will be thrust downwards. In diffuse inflammation of the cellular tissue of the orbit, no one spot will be specially painful, and the protrusion of the eyeball will be more uniform; the skin of the lids becomes involved, and the course of the disease is usually more rapid than in periostitis: nevertheless the diagnosis is often perplexing, but is much simplified if the patient has a history of syphilis.

In periostitis, pain localized;

Exophthalmos one-sided.

The reverse in cellulitis.

*Treatment.* *Treatment.*—If, from the intensity of the symptoms, we have reason to suppose that suppuration beneath the periosteum has taken place, we are justified in exploring the part with a grooved needle; and should we discover the presence of pus, we must at once cut down along the needle upon the collection of matter, and allow it free exit. If this is not done, destruction of the bone will surely occur, or, it may be, the inflammatory action will extend to the lining membrane of the skull.† I need hardly remark that great caution should be exercised in making an incision into the orbit, on account of the complicated anatomy of the parts, but we are bound, nevertheless, to operate without hesitation. I have in several cases of the kind, after exploring the part with a grooved needle, run a director along the groove of the instrument, and so torn open the cellular tissue, simply incising the skin, so as to give exit to the pus.

Explore the part.

Give exit to matter.

Iodide of potassium. In cases of periostitis connected with syphilis full doses of iodide of potassium will control, if not cure the disease.

NECROSIS OF ORBIT. NECROSIS.—Necrosis of one or more of the bones of the

* A. Gräfe on Exophthalmos: *Ophthalmic Review*, vol. i. p. 137.

† Poland on Protrusion of the Eyeball. Case of severe cerebral symptoms, coma and death, following an internal node of the orbit: *Ophthalmic Hospital Reports*, vol. ii. p. 225.

orbit, as has just been remarked, may follow periostitis, or it may take place in consequence of direct violence, or from inflammation of the cellular tissue of the orbit. I have had a case of this kind lately under my care. A man of the name of Tait was exposed to severe cold; the following day inflammation of the cellular tissue of the right orbit set in, and at the end of fourteen days a considerable quantity of pus escaped through an opening at the inner and upper part of the superior eyelid. Ultimately a fistula formed in this situation, and small portions of necrosed bone have since been constantly coming away. When I saw this man for the first time dead bone was felt in the roof of the orbit, he was blind with the right eye, and on making an ophthalmoscopic examination, I found the optic disc atrophied. The inflammatory action had attacked the cellular tissue of the orbit, and extending to the optic nerve, had caused atrophy of the papilla.

Case. Following inflammation of cellular tissue. Ending in atrophy of the papilla.

*Treatment.*—In instances of necrosis, unless exfoliation has taken place, it is better to wait patiently until the dead bone has separated, when it may be cut down upon and removed. The structures contained in the orbit are closely packed and of an important character; except, therefore, in instances unequivocally demanding the use of the knife, it is advisable to be as sparing as possible of its employment.

*Treatment.* Sparing interference.

CARIES OF THE BONES OF THE ORBIT.—The following case affords an instance of the terrible mischief which sometimes results from this disease, especially under injudicious treatment :—

CARIES.

G. C. S., aged eighteen, admitted under my care into hospital on August 20. Up to within the last twelve months he had enjoyed good health, and been employed as a compositor; there was no history of either hereditary or acquired syphilis. A year ago he began to suffer from pain in the head, and shortly afterwards from a discharge of blood and matter from his nose; for this he was salivated, the ptyalism lasting two months; he also had leeches applied to his temples. Some time afterwards, on rising one morning, he discovered that he could no longer see with the left eye, and within a short time the sight of his right eye was destroyed. His digestive system and his mental faculties were perfect; he had lost the sense of smell. The right eyeball

Case. Prolonged salivation. Loss of sight and smell.

protruded considerably, and the cornea was hazy. There was a fistulous opening at the inner part of the left upper eyelid, and through this a probe could be passed far back into the orbit; no dead bone was felt. The left eye was less prominent than the right one, and the dioptric media were transparent: the margin of the optic disc was ill-defined, and like the retina looked cloudy; the retinal vessels of normal size. The patient gradually became weaker, he was troubled with severe pain in the head and often had attacks of obstinate vomiting, but his speech and mental faculties remained perfect. Soon after his admission both eyeballs were observed to throb or pulsate in a most remarkable manner after the slightest exertion, for instance on rising in bed, the pulsations being synchronous with those of the heart.

Fistulous opening.

Cerebral symptoms

Pulsation of eyeball.

The boy died on the 18th of February; the whole of the orbital plate of the frontal bone, and the greater part of the body of the sphenoid had been destroyed by caries, so that nothing but the thickened dura mater intervened between the brain and the tissues contained in the orbital fossa; the pulsation of the globes was thus easily accounted for.

Extensive caries.

FISTULÆ.—Caries of the walls of the orbit is, fortunately, by no means always so destructive as in the case of this lad; the disease is often confined to a small portion of the bones, and a fistulous opening forms between this spot and the skin, through which a thin watery fluid constantly oozes away, and the soft disintegrated bone may be felt with a probe.

FISTULÆ, following caries.

The fistulæ thus formed in cases of necrosis and caries are frequently more troublesome to cure than the disease itself; the external opening is maintained by adhesions to the periosteum, and thus a puckered cicatrix forms, which often leads to eversion of the eyelid.

Fistulous openings of this kind are probably best treated by injecting the *liqueur villate* of the French surgeons, or a similar preparation, into the fistula every third or fourth day.* At first,

Treated by injections.

* The following is the composition of the *Liqueur Villate*, after M. Notta:—Liquid subacetate of lead 30 parts, sulphate of copper and

the injection may cause considerable pain and inflammation, but this soon subsides, and each subsequent injection causes less irritation. In some of these cases not only does the fistula heal under this treatment, but healthy action appears to be excited in the diseased bone. If, as is generally the case, the disease of the bone depends on syphilis, full doses of iodide of potash must be administered.

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## INFLAMMATION OF THE ORBITAL TISSUES.

Acute Cellulitis

INFLAMMATION OF THE CELLULAR TISSUE.—The cellular tissue contained within the orbit is occasionally the seat of acute inflammation and suppuration, but except as a complication of traumatic cases or periostitis this affection is rare; those instances that do occur usually arise from the spread of erysipelas to the part. Under these circumstances the eyeball itself generally escapes, but, unfortunately, the patient's sight is too often much impaired, if not destroyed, from the extension of the inflammatory action to the optic nerve, or from effusion into the retina and its detachment from the choroid. Occasionally the matter burrows into the sheath of the muscles, deranging their action and giving rise to diplopia. A much more serious complication is apt to occur in the course of this disease, in the form of septo-pyæmia.

from the spread of erysipelas

may cause blindness,

or pyæmia.

*The Symptoms* of inflammation of the cellular tissue of the orbit are as follows:—The patient complains of a throbbing pain in the part, extending to the temple, side of the head, and frequently to the muscles of the back of the neck; the pain is sometimes excruciating, and the patient is feverish and restless; if he falls off to sleep he probably suffers from fearful dreams. The eyelids are swollen and of a dusky red colour, the conjunctiva becomes uniformly congested and chemosed, and the eyeball is rapidly protruded to an uncertain extent, in consequence of the effusion that takes place into the cellular tissues of the

Pain.

Fever.

Swelling and discoloration.

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sulphate of zinc each 15 parts, white vinegar 200 parts. — *Medico-Chirurgical Review*, April, 1866, p. 556.

Exophthalmos.

orbit. The globe is usually thrust directly forwards, and not, as in periostitis and in the case of various tumours, with a certain deviation from the axial line, according to the direction of the compressing force. The cornea may remain bright and clear, or it may be that from exposure to the atmosphere, the secretions on its surface, and that of the conjunctiva, form hard dark crusts; the cornea becoming cloudy from desiccation of its epithelium, necrosis follows, and the eye is destroyed.

Suppuration.

In the course of ten or twelve days from the commencement of the attack, we may generally detect one or more points at which fluctuation can be felt, usually at the upper and inner part of the orbit. As soon as the pus has been evacuated, the pain and swelling diminish, the eyeball sinks into its socket, and the parts regain their normal position. But although the eyeball may not be directly destroyed by the inflammatory process, yet, as I have before remarked, in very many of these cases the optic nerve is more or less involved, and is subsequently apt to become atrophied; or necrosis of the bones of the orbit, or the formation of extensive cicatrices, may ultimately lead to atrophy of the globe.

Atrophy of the optic nerve,

or globe.

Chronic Inflammation.

In Chronic Inflammation of the cellular tissue of the orbit the symptoms are less severe than those above described. The patients are generally the offspring of syphilitic parents.

Symptoms as in the acute form,

The inflammatory process usually begins as a gumma in the periosteum, the patient complaining of pain in the part, which increases towards evening, probably extending over the forehead. As the inflammation advances, the cellular tissue of the orbit becomes involved, the conjunctiva and lids are red and swollen, and the eyeball is thrust forward to a greater or less extent; the pain, however, is far less severe than in acute inflammation of the cellular tissue, on account of the gradually increasing pressure to which the parts are exposed. The protrusion of the eyeball in these cases is often considerable, and as their progress is slow, it is only by a careful study of the collateral symptoms that we shall avoid an error in our diagnosis.

but less severe.

Distinguished from orbital tumours

In cases in which a morbid growth causes the eyeball to protrude, its axis usually deviates from its natural position, according to the direction of the pressure occasioned by the tumour (*see* Figs.

11 and 12); whereas in inflammation of the cellular tissue this is not the case. In doubtful instances, we may further satisfy ourselves as to the presence or not of pus in the orbit, by the aid of a grooved needle. and abscesses.

*The Treatment* of inflammation in the cellular tissue of the orbit, differs in no respect from that of similar affections in other parts of the body. In the early stages of the more sthenic forms of inflammation in this situation, we may endeavour, by leeches and cold compresses constantly applied, to allay the action going on in the part, and to prevent suppuration; but if this does not succeed, we must then employ poultices and hot fomentations. As soon as matter has formed, the abscess should be incised, the pus evacuated, and a drainage tube introduced. Cotton wool pads should be substituted for poultices. Leeches. Cold compresses. Poultices.

If the case is complicated with erysipelas, I need hardly say that antiphlogistics are not to be thought of; on the contrary, the patient's strength must be supported, the pulse and the temperature of the body being our safest guides as to the amount of nourishment and stimulants required. I have faith in the perchloride of iron in these cases: fifteen drops of the tincture should be given every six hours, with as many grains of chlorate of potash. Opium, or still better, the chloral hydrate, will be required to enable the patient to sleep; indeed, in the early stages of this form of the disease, there is no better practice than to give the system rest, and at the same time support his strength with soup and stimulants, administering also the tinct. ferri sesquichlor.; we may thus hope to ward off the suppurative stage of the affection, or at any rate promote its speedy termination. We must bear in mind the fact, that so long as the inflammatory action lasts, the close proximity of the parts to the brain endangers its extension to the cerebral membranes. Stimulants in erysipelas. Tr. ferri. Opium. Chloral. Support the patient. Brain in danger.

INFLAMMATION OF THE CAPSULE OF TENON (p. 1) occasionally occurs in rheumatic subjects; in other cases it is said to arise from injuries to the part, or it may be from extension of erysipelas from neighbouring structures.* INFLAMMATION OF CAPSULE OF TENON.

*Symptoms.*—The subconjunctival tissue is deeply injected, Subconjunctival injection.

* "Maladies des Yeux," Wecker, vol. i. p. 696.

but the iris is healthy, nor can we easily account for the persistent chemosis and injection of the vessels in question. The
Pain. patient complains of slight pain in the eye, particularly when he turns the eyeball from side to side, but there is no impairment
Exophthalmos. of vision; slight protrusion of the eye may occur, and the mobility of the globe be impaired, so that diplopia may exist.

The symptoms above described usually disappear for a time, and no serious consequences are likely to follow, unless in cases preceded by erysipelas, when the optic nerve is liable to become involved, optic neuritis and atrophy of the papilla resulting.

Warmth. *Treatment.*—Hot compresses generally give the patient much
Pot. iodid. relief, and iodide of potassium in large and repeated doses often appears to be very serviceable.

## ORBITAL GROWTHS AND TUMOURS.

Exophthalmos. EXOPHTHALMOS, or protrusion of the eyeball, may be conveniently considered under two heads :—

Varieties. 1st. Protrusion of the eyeball arising from an increase in the contents of the orbit—as, for instance, from hypertrophy of its cellular tissue, or the growth of a tumour.

2nd. From diminution of the cavity of the orbit, by the encroachment of its walls upon the eyeball—as, for example, in cases of bony tumours springing from the walls of the orbit, or from an abscess of the antrum forcing the inferior wall upwards.*

Exophthalmic Goitre. EXOPHTHALMIC GOITRE.—Among the most remarkable of the affections of the orbit included under the first heading, is exophthalmic goitre, described by Dr. Graves,† and more fully elucidated by his friend, the late Professor Trousseau, in his
Nervous origin of. admirable clinical lectures. He considers that exophthalmic goitre arises from a neurosis of the sympathetic, resulting in local congestions, the proximate cause of which is an alteration
M. Trousseau's view. produced in the vaso-motor apparatus. "It is a morbid entity,

* "Maladies des Yeux," Wecker, vol. i. p. 705.

† "Clinical Lectures," p. 587.

because it presents special phenomena; palpitation, and congestion of the thyroid gland and of the eyeballs. It is a pathological variety of the great class of neuroses, with a paroxysmal course, and should be regarded as entirely distinct from ophthalmos due to organic diseases of the heart, while it cannot be confounded with goitre proper."*

Dr. T. Laycock remarks that exophthalmic goitre occurs under a variety of morbid conditions of the nervous system. When the exophthalmos is symmetrical, it is spinal, the cervical and dorsal regions of the spinal cord being the seat of the disease, together with the corresponding cervical and dorsal divisions of the sympathetic; but when unsymmetrical, it is due to disease of the trigeminal ganglion, and branches of the fifth pair.† In either case, it seems probable that from irritation of the sympathetic, hypertrophy of the adipose tissue, and dilatation of the veins of the orbit occur. Dr. Laycock's view.

Exophthalmic goitre is almost confined to the female sex. Out of fifty cases referred to by Withusen, only eight occurred in men.‡ It may be induced by moral causes, or by privations which have produced excessive anæmia. Rare in men

*Symptoms.*—The symptoms of this remarkable disease are, in the first instance, nervous irritability, a sensation of fulness in the head and face, violent palpitation, usually coming on in paroxysms. In the case of female patients, menstruation generally becomes disordered. Some enlargement of the thyroid gland generally occurs, and protrusion of the eyeballs, alike on both sides, commences. This may be very gradual in its progress, and is preceded by obvious changes in the integrity of the muscular apparatus of the eyes, their axes being inverted; the eyes have also a remarkable staring expression due to retraction of the upper eyelid; the lid fails also to follow the Palpitation. Goitre. Protrusion of eyeballs.

* "Lectures on Clinical Medicine," by A. Trousseau; translated by Dr. Bazire, p. 579.

† On the Cerebro-Spinal Origin and Diagnosis of the Protrusion of the Eyeball, commonly called Anæmic, by Dr. T. Laycock: *Medico-Chirurgical Review*, July, 1863, p. 251.

‡ *Dublin Medical Press*, vol. xlii. July, 1859.

movements of the globe of the eye as the plane of vision rises and falls—it remains too much elevated, so that when the eyeball is directed downwards more or less of the sclerotic is exposed. The eyeballs continue mobile, but may in time become so far protruded as to prevent the patient from closing the eyelids over them. In one case mentioned by Trousseau, "the eyeballs were thrust out of the orbit;" but this, of course, is a rare occurrence. In other instances, the eyeballs are only slightly protruded; but their lustrous appearance, the enlargement of the thyroid gland, together with palpitation and other nervous symptoms, are pathognomonic of the malady.

No cardiac lesion.

The affection does not depend upon disease of the heart, although palpitation exists, and frequently a systolic (anæmic) murmur at the base, but no structural changes, as a general rule, can be detected in this organ.

Vision retained.

The patient complains of shortness of sight, and difficulty in keeping her eye fixed on any one object, but beyond this there is seldom any impairment of vision. The ophthalmoscopic appearances of an eye affected in this way indicate congestion of the retina and choroid; but the dioptric media may remain transparent.

Prognosis favourable.

*Prognosis.*—In some cases, after a very considerable interval, exophthalmic goitre gradually disappears of itself, the patient's general health improves, the palpitations and other nervous symptoms from which he suffered abate, and the enlargement of the thyroid gland, and protrusion of the eyeballs, subside. Suppuration of the cornea and destruction of the eye may, however, occur, from the exposure of the uncovered cornea to the air, or it may be due to paralysis of the "trophic" fibres of the fifth nerve. On the other hand, if the anæmia increases the disease becomes a most formidable one, requiring the greatest care with regard to diet, and, above all, freedom from mental anxiety and worry.

*Treatment.*

*Treatment.*—From the foregoing history of this malady, we learn that it is no mere local affection, and the remedial measures we adopt must therefore be mainly directed to restore the general health and secure rest of mind. As the large majority of cases occur in women, and are attended with catamenial derangement from their commencement, and often with

Promote the general health.

anæmia, our treatment should be further directed by attention to these special features.

Trousseau recommends a judicious use of hydropathy, among other measures, as likely to improve the patient's general health; and he regards this as being the best and only rational plan of treatment in such cases. Galvanization of the cervical sympathetic with a weak ascending current, not only lessens the size of the thyroid gland, but seems to exercise a favourable influence on the course of the disease.* A firm compress and bandage may be employed with advantage over the closed eyelids, especially if the cornea becomes at all hazy. Should the retraction of the upper lid be very marked, the following operation has been proposed. The horn spatula having been introduced beneath the lid to be operated on, a horizontal incision is to be made through the skin of the lid above, and parallel to the upper border of the tarsal cartilage. A portion of the fibres of the orbicularis muscle, and subjacent fascia, is to be divided so as to expose the levator palpebræ; and those fibres of this muscle which pass over and into the tarsal cartilage are to be very carefully cut through. An incomplete ptosis results, but this gradually diminishes, and neutralizes the retraction of the lid, if the operation is successful.† Hydropathy.

CYSTIC TUMOURS growing within the orbit are another cause of exophthalmos. In this situation, such tumours are usually attached to some portion of its bony wall. Their contents vary, being sometimes watery (hygroma), like suet (steatoma), like pap (atheroma), or like honey (meliceris). They often contain a number of hairs. Cystic Tumour of Orbit. Contents various.

It is almost impossible, before operating, to ascertain the exact connections or depth to which these cysts extend within the orbit; they sometimes extend backwards, not only into the orbit, but through the optic foramen, and as they are liable to suppurate at any time, they may excite dangerous inflammation of the tissues contained within the cranium.

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* *The Practitioner*, 1873, p. 186.

† *Compte-Rendu of the Congrès d'Ophthalmologie*, 1867.

Absence of pain. Slow growth.

*Symptoms.*—Cystic tumours in this situation usually increase in size very slowly, and without causing the patient pain or much inconvenience, until they attain a considerable bulk and begin to displace the eyeball, forcing it forwards in the opposite direction from that in which they grow. When they have reached this size, on everting the lids, the cyst may generally be seen projecting from between some part of the orbital walls and the eyeball; it has usually a bluish tint, and fluctuation may be felt in it if the cyst happens to have fluid contents. Follicular cysts, however, often enclose sebaceous-like matter, when no fluctuation can be detected. In doubtful cases, we should do well to use the aspirator before deciding as to the nature of the disease.

Bluish tint. Fluctuation.

Explore with an aspirator.

*Treatment.*

*The Treatment* to be pursued in instances of this kind is by no means so simple as might at first sight appear. It may be well in the first place to draw off the contents of the cyst, if they are fluid by means of the aspirator, but it will reform; and if the cyst is a large one, hæmorrhage may take place into it, and suppuration ensue. As a rule the better course is to remove the cyst, as far as that is practicable. Should it extend so deeply into the orbit as to prevent our taking it away entire, we must content ourselves with removing as large a portion of it as possible. To do this, it is often necessary to make a free incision through the eyelid; in fact, a sufficiently large incision must be made through the lid to expose the tumour fully, and allow the cyst to be dissected away. Or, if it should seem more desirable, the outer canthus may be slit up and the lid everted with the same intention.

Remove the entire cyst.

HYDATID CYSTS.

HYDATID CYSTS of the orbit are occasionally met with, and these, as they increase in size, must necessarily displace the globe of the eye. If the tumour projects between the orbital walls and the globe of the eye, it may be felt as a firm, elastic swelling; and as it generally yields an obscure sense of fluctuation, the case may closely simulate one of chronic abscess. The aspirator will settle the point; a colourless limpid fluid, containing echinococci, being drawn off by the instrument.

Remove contents.

In these cases the cyst must be opened, and the included bag

should, if possible, be removed; this done, the cavity in which it has grown will probably close up and cicatrize.*

SANGUINEOUS CYSTS are occasionally met with in the orbit, either of spontaneous origin, or as the result of an injury. It is almost impossible to discriminate between a tumour of this description and an ordinary cyst, unless by the exploring needle or the aspirator. The symptoms and progress of these tumours differ in no way from those of other cystic growths: as they increase in size they cause more or less displacement of the eyeball, and diplopia. It is seldom sufficient simply to puncture a tumour of this kind, and evacuate its contents, for the tumour is then almost sure to form again. The whole of the cyst should, if practicable, be removed.† Sanguineous Cysts. Remove the cyst.

SARCOMAS are not of unfrequent occurrence in the orbit, and they usually grow from the periosteum. A sarcoma may take a long time to grow, and in the first instance be mistaken for a node; but the absence of a syphilitic history would lead us to dismiss the idea of periostitis while the smooth and softer surface of the growth precludes the supposition of an exostosis. As the morbid growth increases in size, exophthalmos, or displacement of the eyeball occurs, and gives rise to diplopia. (Fig 11.) Sarcoma. May be mistaken.

These tumours have often extensive attachments to the walls of the orbit, although they may only appear as a small, hard, and nodulated mass upon an external examination. If allowed to remain undisturbed they continue steadily growing, the skin covering them in course of time ulcerates, an open sore is established, and the patient's health gradually fails. The follow-case illustrates the history of a case of this kind:— Extensive attachments.

S. D., aged thirty-two, states that he had a small tumour removed from the near inner angle of the left eye, about four years ago. We can obtain no clue to the nature of this morbid growth Case.

* "A Treatise on the Principles and Practice of Ophthalmic Medicine and Surgery," by T. W. Jones, 3rd edit. p. 738. Also *Australian Medical Journal*, No. 10, p. 243: case reported by Mr. P. H. MacGillivray.

† Poland on Protrusion of the Eye: *Ophthalmic Hospital Reports*, vol. i. p. 24.

Growth slow and painless.

A year after the operation a tumour again commenced growing in the same situation; it caused him no pain.

FIG. 11.

At present a morbid growth is seen situated towards the inner part of the orbit (Fig. 12). It has evidently deep-seated attachments, and feels hard to the touch; the skin is not involved. The left eyeball is displaced by the tumour an inch outwards, and fully one inch forwards, from its normal position; nevertheless the eye moves in unison with the other one, and its sight, for both near and distant objects, is perfect. The patient's general health is good, and no enlargement of the glands of the neck exists.

Eye displaced.

Health good.

Removal.

I proceeded to remove the morbid growth, at the same time endeavouring to save the eyeball.

After making the necessary incisions through the skin, and exposing the tumour, I found that it was attached to the lower

and also to the inner walls of the orbit; I consequently removed not only the morbid growth, but also cut away a considerable

FIG. 12.

(From a Photograph.)

part of the bones with which it had been united. Lastly, the wound was filled with lint soaked in the chloride of zinc paste. Caustic applications.

The cornea became hazy immediately after the application of the paste, and subsequently sloughed, the eyeball collapsing; but, excepting this loss of the eye, the case progressed most favourably, and the wound healed and cicatrized. Four years subsequently this patient returned to the hospital; a small bleeding fungoid mass was growing from the site of the original tumour, the glands of his neck were enlarged, but the man appeared otherwise healthy. Results.

This case fairly represents the circumstances of the majority of sarcomatous tumours of the orbit which we meet with in practice. It is true the pigmented forms of sarcoma are not more common in the orbit than elsewhere; like most of the osteo-sarcomas they contain well-marked examples of myeloid cells; but these cells,

as I have explained, are in truth derived from the cells found in the medulla and in the deep layers of the periosteum. Sarcomas springing from the walls of the orbit frequently have a skeleton of osseous tissue; they are, in fact, osteo-sarcomas.

My belief is that, in undertaking an operation for the removal of a tumour of this description, we must be guided more by the history of the case than by the histology of the tumour. Should the morbid growth have grown rapidly, I agree with Dr. C. S. Bull, of New York, that if the "bones of the orbit are involved, operative interference should not be attempted—the small amount of good attained by an operation is but temporary, and is far outweighed by the dangers of the operation, the severity of reaction, and the rapid recurrence of the growth." On the other hand, if the tumour has increased in size very gradually, taking perhaps years to grow, we are justified in removing it, and destroying the surface of bone from which it originated, by means of the chloride of zinc paste.

Bony Tumours of Orbit.

OSSEOUS TUMOURS OF THE ORBIT — that is, tumours consisting of bone without sarcomatous elements—may grow from any part of the walls of the orbit; they most frequently present a nodular form, and are of an ivory-like texture. Sir James Paget is of opinion that they usually originate in the diploë or neighbouring sinuses, as isolated or narrowly attached masses; their tendency being to extend in all directions.

*The Symptoms* to which an exostosis in the orbit gives rise, will vary somewhat with its position, and the rate at which it grows. The globe of the eye is pushed forwards before the morbid mass, and protrudes to a greater or less extent from its socket. Pain is by no means a prominent symptom in these cases, and frequently we hear no complaints of it from the patient. As soon as the tumour attains a considerable size, it may be felt as a hard, rounded, or spiculated mass attached to the bone, sometimes by a broad base, at other times pedunculated.

Exophthalmos.

Pain little.

Tumour hard and fixed.

*Treatment.* — It is seldom possible to remove these bony

*Treatment.*

tumours of the orbit, in consequence of their tendency to penetrate into the skull. Nevertheless, instances have been recorded in which tumours of the kind have been cured by Nature, the ivory-like mass sloughing away; and it may be well, as Sir James Paget remarks, to expose tumours of this description, by making incisions through the soft parts covering them, and applying, if need be, escharotics to the surface of the bone.*

Ophthalmic Aneurism.

ANEURISM OF THE OPHTHALMIC ARTERY is said to have been met with occasionally.† The quick development of such a tumour, causing the eyeball to be considerably protruded, its pulsating character, accompanied by an aneurismal bruit distinctly audible on placing the stethoscope above the supra-orbital ridge, together with the absence of symptoms indicating any other form of disease—these features would appear to be sufficient for the purposes of diagnosis; but we shall see hereafter that, in cases of this kind, we can never speak very confidently as to the exact seat of the lesion.

Protrusion and pulsation of eyeball. "Bruit de diable."

Ligature of carotid.

The only treatment we can adopt, with any hope of success, for the cure of an aneurism so situated, is to apply a ligature round the corresponding common carotid artery. We should hesitate, however, to have recourse to so serious an operation, unless pressure made upon the artery either stops, or at any rate lessens, the pulsation of the globe. ‡

Diffused Aneurism.

A DIFFUSED ANEURISM has been known to form in the cellular tissue of the orbit, as in other parts of the body, in consequence of an injury, or spontaneously from disease and rupture of a vessel and effusion of blood into the cellular tissue of the part, producing some slight exophthalmos. As the protrusion

Exophthalmos.

* Paget's "Lectures on Surgical Pathology," 3rd edit. p. 536.

† "Lectures on the Operative Surgery of the Eye," by G. J. Guthrie, p. 169: London, 1827. Where a fatal case of true aneurism of the ophthalmic artery on both sides, preventing operation, is recorded.

‡ Case of supposed aneurism, by Dr. Morton, successfully treated by ligature of common carotid: *Ophthalmic Review*, vol. ii. p. 198. Another case is reported by Mr. Poland, *Ophthalmic Hospital Reports*, vol. ii. p. 219.

of the globe increases, the vessels of the conjunctiva become congested and swollen, and the movements of the eyeball are improved. The eyeball pulsates, and the arterial souffle may be heard in its neighbourhood; this may be stopped if the eyeball be gently pressed back into its socket, and the pulsation of the globe ceases at the same time, to be renewed the moment the compressing force is removed. If the pressure is discontinued, the eyeball slowly protrudes to the same extent as before the compression was made.

Bruit and pulsation stopped by pressure.

Should the symptoms make their appearance after an injury to the part, we should be led to suppose that an effusion of blood has taken place in the loose cellular tissue of the orbit, and that the clot, having been partly absorbed, has left an aneurismal sac communicating with the injured vessel. In other instances similar changes are said to have occurred after a severe strain, probably not noticed by the patient at the time, but which has caused the rupture of an artery already in a diseased condition, and thus given rise to an aneurism.

Arising from injury

or disease of vessels.

On the other hand, we must remember that pulsating tumours of the orbit may occur in consequence of a fracture of the base of the skull, involving the internal carotid artery in the cavernous sinus, and giving rise to symptoms such as those I have above referred to; in fact, increased pulsation of the ophthalmic artery or its branches, as well as obstructions in the ophthalmic vein or cavernous sinus, will produce pulsation of the eyeball, as will a rapidly growing sarcoma.

Diagnosis difficult.

The nature of pulsating tumours of the orbit are consequently very difficult to diagnose; and it is more by the careful exclusion of other forms of disease, than by any positive indications, that we can arrive at a satisfactory diagnosis. Compression of the carotid generally causes a marked diminution of the bruit, and is sometimes accompanied by fulness and pain in the head.*

*Treatment.* Ligature of carotid.

*The Treatment* of false aneurism in this situation will be the same as that of true aneurism, and consists in tying the cor-

* *Lancet*. vol. i. p. 473 of 1875; Mr. W. Rivington, On Pulsating Tumours of the Orbit.

responding common carotid artery.* Digital compression of the carotid has proved successful in a few cases; in one recorded instance it was continued for fifty-six hours without avail. It is advisable when practicable under these circumstances, to raise the carotid and compress it between the fingers, rather than attempt to fix it against the spine. But little dependence can be placed on other remedial measures, yet a remarkable case of aneurism successfully treated by the administration of ergot and veratrium, is reported in the *Ophthalmic Review*, vol. i. p. 288.

ERECTILE TUMOURS may form in the cellular tissue of the orbit; they are painless growths, and usually increase very slowly, the patient's health remaining unimpaired. As the vascular tumour augments in volume, it causes more or less exophthalmos, and the prominent eyeball has a pulsating movement imparted to it; this ceases, however, on gentle backward pressure being exercised on the globe of the eye, the eyeball may thus also be made to recede into its normal position. The size of the tumour increases if the patient makes a straining effort, as in crying. If the erectile mass projects forward beneath the conjunctiva, the colour and general characters of the morbid growth will be more apparent, and render the diagnosis comparatively easy.

Erectile Tumours. Painless.

Pulsating exophthalmos.

Recedes on pressure.

*Treatment.*—A case of this kind is probably best treated by ligature of the carotid,† unless the erectile tumour is of small size; we may then be justified in attempting to obliterate the vessels, by means of injections of perchloride of iron, or tannic acid, into the morbid growth; but great care is necessary in a proceeding of this kind, for it is hardly possible to limit the extent or direction in which the injected fluid will run, or to

Ligature of carotid.

Injections.

* Lawrence, "On Diseases of the Eye," p. 766, where two cases successfully treated in this way are recorded, one by Mr. Travers, the other by Mr. Dalrymple. See, also, *Medico-Chirurgical Transactions*, vol. ii. pp. 1–16 and plate, and vol vi. pp. 111–123.

† Desmarres records a case in which such a tumour was removed, together with the eye, by Dupuytren: "Maladies des Yeux," vol. i. p. 234.

prevent it entering some of the larger vessels: the galvanic cautery would seem to be well adapted for the treatment of erectile tumours in the orbit, a small portion of the growth being dealt with from time to time.

Fallacies in diagnosis.

To the foregoing account of vascular tumours in the orbit, it should be added, that they are very rarely met with, and their diagnosis is at all times difficult and uncertain. Cases of pulsating, vascular protrusion of the eyeball, exhibiting most of the features above described, as characteristic of those affections, sometimes present themselves; but in most of them it is doubtful whether the disease is really within the orbit. Several cases of supposed orbital aneurism have proved to be of a different nature, when the opportunity has been afforded of correcting the diagnosis by a *post-mortem* examination, and hence the unavoidable inference that others may have had no better claim to be so regarded. Mr. Nunneley, who has had an unusually large experience in such cases, believes that aneurism within the orbit, whether true or diffuse, is almost unknown. He remarks, that in a large majority of instances of "vascular protrusion of the eyeball, there is no disease whatever in the orbit; the seat of it is mostly intra-cranial. The protrusion of the eyeball is passive, and the other distressing symptoms are secondary, depending on obstruction to the return of the blood through the ophthalmic vein."* Cases are recorded in which all the symptoms of orbital aneurism have arisen from compression of the ophthalmic vein, preventing the passage of blood from the orbit, as for instance, an aneurism of the ophthalmic artery near its origin. It is satisfactory, however, to know that, whether the seat of the tumour be within the orbit or not, the treatment will be the same, and that ligature of the carotid has been successfully practised under these circumstances.†

Existence of orbital aneurism doubted.

Case in point.

A case, which forcibly illustrates Mr. Nunneley's observations, has been recorded by Mr. Hulke.‡ The patient, five months

* *Medico-Chirurgical Transactions*, xlviii. p. 30. Previous cases and Observations, vol. xlii. p. 167.

† See a case by Mr. Bell, *Medical Journal*, July, 1867.

‡ *Ophthalmic Hospital Reports*, 1859–60, vol. ii. p. 6.

after receiving a blow on the left side of the head, presented all the capital signs of an orbital aneurism—fulness of the left orbital region—protrusion and pulsation of the eyeball—a distinct sibilant bruit heard extensively in the neighbourhood. The common carotid artery was tied, but the patient subsequently died, and on making a *post-mortem* examination, phlebitis of the cavernous, transverse, circular, and petrosal sinuses was discovered.

Compression of Orbit.

EXOPHTHALMOS FROM COMPRESSION OF THE ORBIT.—The cavity of the orbit may, as I have before remarked, be encroached upon by pressure from without as well as by growths from within. In some remarkable cases of chronic hydrocephalus, the accumulation of fluid within the cranium has been known to force the orbital plate of the frontal bones downwards and forwards, causing the eyeballs to protrude so far from their sockets as to prevent the lids from closing over them. It would be useless to dwell longer on the description of such cases as these, as their nature must be at once apparent.

Hydrocephalic.

Distension of the frontal sinus.

*From Diseases of the Frontal Sinuses.*—Distension of the frontal sinus is generally caused by a blow on the face which has fractured some of the anterior ethmoidal or frontal cells, and so induced a closure of the infundibulum, preventing the escape of mucus from the sinus into the nares. The secretion of the frontal sinus being in this way retained, gradually accumulates and expands the sinus, often to a very considerable extent. If the malady cannot be traced to an accident, we may assume that closure of the infundibulum has taken place as a result of disease. The symptoms may be either those of active inflammation, or of a chronic character : in the former case the patient complains of great pain over the brow and root of the nose, the frontal sinus becomes rapidly distended with pus and may burst, the pus finding an exit into the nose or upper part of the orbit. When the latter accident occurs, the abscess protrudes from the inner and upper part of the orbit, pushing the eye in the opposite direction. The upper lid is much inflamed, and the protrusion is very tender ; fluctuation may ultimately be felt in it.

Symptoms.

Displacement of the eye.

In chronic cases of this disease there may be little or no pain, or other symptoms of inflammation; but the gradual formation of a tumour, at the upper and inner part of the orbit, protruding the eyeball downwards, outwards, and forwards. The disease is usually confined to one sinus, but may attack both.

*Treatment.* If, from the bulging condition of the frontal bone and pain in in the part, we are led to believe that the sinus is so distended with fluid, it will be advisable to cut through its bony walls and allow the pent-up matter to escape.*

In a case recently under my care, I followed out with complete success the plan of treatment recommended by Mr. G. Lawson. He says:—A single curved incision parallel with the fold above the lid is to be made over the most prominent part of the tumour, and having by a little dissection exposed its surface the scalpel should be plunged into it, and an opening made to the extent of the incision. The index finger of the right hand is now to be pushed into the sinus through the wound, to ascertain the size of the cavity and if there is any necrosed or carious bone. Whilst thus exploring the sinus, the little finger of the left hand should be passed up the corresponding nostril, and an endeavour made to find out the spot at which the tip of the finger in the sinus will approximate most closely the end of the one in the nose. After a little search it will be found that at one part the fingers will almost meet, there being only a thin plate of bone between them. Having gained this information, the finger in the frontal sinus is to be withdrawn, but that in the nostril is to be retained *in situ* to act as a guide to the gouge or elevator, which is to be passed into the sinus and made to force a passage into the nose through the lamina of bone on which the tip of the little finger is resting.

Open the sinus.

Force a passage to the nose.

A communication between the frontal sinus and the nose having been thus established, an india-rubber drainage tube, with holes cut at short distances, is to be introduced, one extremity of which is to be afterwards fastened on the forehead,

* See the report of a case in which this operation was successfully performed by J. W. Hulke; *Ophthalmic Hospital Reports*, vol. iv. p. 176.

whilst the other end protrudes slightly from the nostril. The easiest way of introducing the drainage tube is to pass a probe with an eye up the nostril and out of the wound, and having fastened the tube to it by means of a piece of string, to draw it back again through the nose. The object of the drainage tube is to keep the channel between the two cavities from closing, and to enable the attendant to wash out the frontal sinus at least twice a day with some astringent and disinfectant solution. For the latter purpose the lotio alum. cum zinc. sulph., or the lotio acid. carbolic. may be injected with a glass syringe through one of the openings at the upper extremity of the tube. The drainage tube should be worn for five or six months, or until all discharge from the nose had ceased. The results of these cases when thus treated are usually most satisfactory.* Inser drain tube.

Hydatid cysts and polypi have occasionally been met with distending the frontal sinus.† Hydatids and polypi.

*From Diseases of the Antrum.*—The orbital fossa, however, is more frequently encroached upon from below than from any other direction, in consequence of malignant growths, or the accumulation of fluid within the antrum, forcing the orbital plate of the maxillary bone upwards.

Abscess of the antrum or an accumulation of its natural secretion from closure of the passage leading into the nose, may distend the walls of this cavity to such an extent, that the hard palate, cheek, and orbital plate of the bone are thrust outwards; and in this way the orbital fossa may be so far encroached upon, as to occasion some protrusion of the eyeball. Abscess of antrum.

A polypus growing from the walls of the antrum, or from the nostril, may, by its gradually increasing size, so far displace either the inner or inferior wall of the orbit, as to lessen the dimensions of the orbital fossa. In these cases the distortion of the face will render the diagnosis comparatively easy; mistakes however do occur: Mr. Poland relates an instance in point; he says, "Only a short time back there was a case where excision of the eyeball was actually proposed for this Polypus. Diagnosis.

* "Diseases and Injuries of the Eye," by G. Lawson.

† "Mackenzie, "On Diseases of the Eye," 3rd edit. pp. 55–58.

affection, when it was discovered that the protrusion was due to an abscess in the antrum, which was opened, and the eye saved and resumed its natural place."* Such a history as this shows a want of forethought and consideration against which it is impossible to arm individuals, however profuse or practical our rules may be.

The following table drawn up by Mr. Poland exhibits the causes of protrusion of the eyeball:—

Causes of Protrusion of the Eyeball.

1. Congenital
   1. *Real* protrusion.
   2. *Apparent*—from shortening of levator palpebræ and lids.
2. In the eye itself
   1. Inflammation of globe, ophthalmitis.
   2. Phlebitic ophthalmitis.
   3. Hydrophthalmos.
   4. Tumours in eye
      1. Sarcomas.
      2. Carcinomas.
      3. Hydatid.
3. Within orbit
   1. Inflammation of cellular tissue—idiopathic and traumatic.
   2. Suppuration and abscess.
   3. Erysipelatous and phlegmonous inflammation.
   4. Foreign bodies.
   5. Excess of development of fat.
   6. Tumours.
      1. Encysted.
      2. Hydatid.
      3. Sarcomas.
      4. Osseous.
   7. Aneurism and effusions of blood.
   8. Venous congestion; exophthalmic goitre.
   9. Paralysis of muscles of eyeball—ophthalmoplegia.
   10. Spasm of muscles of eyeball, as in tetanus.
4. External to orbit
   1. Above—Nodes, hydrocephalus, fungus of dura mater, polypi in frontal cells and diseases thereof, tumours of brain, inflammation and diseases of lachrymal gland.
   2. Below—Diseases of the antrum.
   3. Internal—Nasal polypi and tumours.
   4. External—Exostosis.
   5. In front—Contraction of lids, and eyes slipping through, hernia oculi.

## DISLOCATION OF THE EYEBALL.

DISLOCATION OF EYEBALL.

Dislocation of the eyeball exists when the eye has been forced out of the orbit, as for instance, by a foreign body being thrust between it and the orbital walls. I saw an instance of this kind

Case.

not long since. The patient was a sailor, and in a quarrel with a comrade had had his left eye gouged out. The eyeball was hanging down on the poor fellow's cheek, and as the whole of

* *Ophthalmic Hospital Reports*, vol. i. p. 22. † *Ibid.* p. 22.

the tissues at the posterior part of the eyeball had been torn from their attachments, and with them apparently the optic nerve, it was useless attempting to save the eye.

Cases are on record, however, where an eye has been dislocated, the patient, for the time being, having entirely lost his sight, but on the eye being replaced in its socket vision has been restored.* Except therefore in cases where we have evidence that the optic nerve has been divided, it will be well to separate the eyelids and restore the dislocated eye to its socket. A firm compress and bandage should subsequently be applied over the closed eyelids, so as to keep the eyeball in its place. If at the end of four or five days the patient has no perception of light, it will be advisable, if practicable, to examine the eye with the ophthalmoscope, and should the retina be detached from the choroid, or the optic disc atrophied, it would be useless attempting to save the eye, and better to extirpate it at once, substituting an artificial eye.

Where the nerve is whole,

Replace the eye.

Apply a compress.

If vision lost, remove the eye.

If, on the other hand, the patient has the least perception of light, four or five days after the accident, in the injured eye, we must retain it in its place by a pad and bandage for three weeks or so. The firmer the compress can be worn the better, the eyeball being forced back into the orbit by this means, and giving the divided muscles the best opportunity of forming adhesions near the anterior part of the eyeball, so as to reduce, as far as possible, the amount of exophthalmos and diplopia which must result from an accident of this kind.

## EXTIRPATION OF THE EYEBALL.

Extirpation of the eyeball may be rendered necessary by the presence of foreign bodies in the eye, or other injuries; by staphyloma, sympathetic irritation, and other diseases. The operation is performed as follows :—

Extirpation of Eyeball.

The patient having been laid on the operating table and chloroform administered, a stop speculum or retractors are

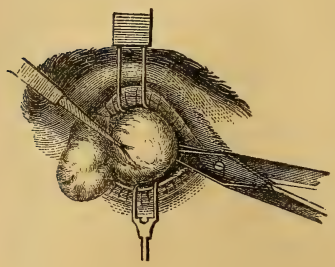
Operation.

* Mackenzie "On Diseases of the Eye," 3rd edit., p. 13.

introduced, so as to keep the eyelids well apart. A fold of conjunctiva having been laid hold of with a pair of forceps, the mucous membrane, sub-conjunctival tissue, and capsule of Tenon are to be cut through all round the cornea, with a pair of slightly curved scissors, so as freely to expose the sclerotic; the straight and oblique muscles are then to be divided close to their insertion into the sclerotic, with a few strokes of the scissors; this manœuvre is facilitated by dragging the eyeball in the opposite direction to that of the muscle whose tendon we are about to divide; or we may take up each of the recti muscles on a strabismus hook, and divide them one by one. The eyeball being thus separated from its muscular attachments, is to be seized and drawn well forward; the curved scissors may then be passed behind it (Fig. 13), and the optic nerve divided close to the sclerotic, together with any other structures which prevent our entirely removing the eyeball.

Extirpation.

FIG. 13.



As a rule the bleeding after this operation may be arrested, by means of pressure kept up for a few minutes by an assistant, with a sponge thrust into the cavity from which the eyeball has been removed, and no arteries will have to be tied; but it is well to have ice at hand in case of hæmorrhage. The stop speculum having been removed, a sponge or pad of wet lint is to be applied over the closed eyelids, and retained there with a light bandage round the head. The use of sutures to bring the edges of the conjunctival wound together are in my opinion unnecessary, and likely to set up irritation; compresses of lint or a sponge inserted within the orbit, except for a few minutes as above directed, after the removal of the globe, are not called for to restrain hæmorrhage, and are consequently only to be employed in exceptional cases to stop excessive bleeding.

Hæmorrhage trifling.

The subsequent treatment of these cases consists in keeping

After-treatment.

the parts clean, and to do this properly it will be necessary to open the eyelids from time to time, and syringe out the wound with a weak solution of carbolic acid.

It will be noticed that in this operation the globe of the eye is removed from within the capsule of Tenon* (*see* Fig. 1), without wounding the cellular tissue of the orbit; the muscles, nerve, and, in fact, the attachments of the eyeball being divided close to the sclerotic. Should the patient wish for an artificial eye, the contracted capsule of Tenon, with the muscles attached to it, forms a very good stump upon which the glass eye may rest.

Capsule of Tenon preserved.

ARTIFICIAL EYES.—An artificial eye is made of a hollow hemisphere of enamel, coloured so as to resemble the front of the other eye.

ARTIFICIAL EYES.

It was formerly the practice in removing the globe of the eye to cut wide of the sclerotic, and in fact to take away the greater part of the contents of the orbit. One of the advantages of the operation of excision, as now performed, is, that the capsule of Tenon, with the attachments of the muscles, is left in the orbit, and forms a movable stump upon which an artificial eye may rest, and thus move in harmony with the sound one. A still better support is afforded by the operation of abscission, to be hereafter described. (*See* chap. viii.)

Advantages of modern practice.

Improved stumps.

In some cases, after the eye has been destroyed by purulent conjunctivitis or other causes, we may with advantage fit an artificial eye over the atrophied eyeball.

Care is necessary in adapting the artificial eye to the requirements of individual cases, and this can best be done by the manufacturer; or a cast of the outer part of the orbit may be made and forwarded for his guidance.

Adaptation to stump.

Under any circumstances, the false eye should not be worn until all inflammation and irritation have disappeared.

In introducing it, the upper eyelid must be raised, and while the patient looks downwards, the upper border of the artificial

How introduced.

* "Lehrbuch der praktischen Augenheilkunde." Von K. Stellwag von Carion. Wien, 1864, p. 553.

eye should be pushed beneath the lid, which is then allowed to fall: and the lower one being in turn depressed, a little manipulation is sufficient to make the remaining portion of the eye slip into the lower palpebral sinus.

How removed.

In removing the artificial eye, the lower lid must be everted, and the thumb-nail, or the point of some instrument, may be introduced under the lower edge of the eye; it is thus lifted away from the remains of the globe, and falls down into the open hand, or upon a soft cushion ready to receive it.

Precautions.

After being withdrawn, the artificial eye should be dipped in water and cleansed. Under any circumstances it is liable to get corroded and rough in course of time, and then sets up much conjunctival irritation. Whenever this is the case, or if, independently of changes in the surface of the glass, it causes the patient any inconvenience, it should not be worn; otherwise it may excite dangerous sympathetic irritation in the other eye.

The artificial eye should always be removed at night, and only worn at first for a few hours during the day.

## DISEASES OF THE LACHRYMAL GLAND.

Inflammation.

Inflammation of the Lachrymal Gland may be either acute or chronic; the former is an affection seldom met with.

Rare.

Chronic inflammation of the gland is also a rare form of disease, occasionally seen among people affected with scrofula. The secluded position of this gland preserves it from injuries by direct violence; on the other hand, it favours the propagation

May spread to cellular tissue.

of inflammatory action from the gland to the connective tissue around; and it is thus sometimes impossible to distinguish a case of inflammation of the gland from one of general inflammation of the cellular tissue of the orbit.

*Symptoms.*—In cases of acute inflammation of the gland the

Pain.

patient complains of a severe darting or shooting pain in the orbit, extending over the forehead and side of the head; the

Congestion.

conjunctiva and eyelids become intensely congested and much

Displaced globe.

swollen, the globe of the eye being pressed downwards and forwards, or inwards and backwards. These symptoms are usually accompanied with fever. If the inflammatory action

advances, fluctuation will soon be felt generally at the upper and outer part of the orbit, and after a time matter bursts through one or more openings in the upper eyelid, and the abscess having discharged its contents, the swelling and inflammation gradually subside. It sometimes happens, however, that the periosteum, and subsequently the bone in the immediate vicinity of the gland, becomes involved, in which case a fistula forms, and remains open so long as the diseased action in the bone continues. Suppuration.

*Treatment.*—In acute inflammation, we may endeavour, in the early stages of the disease, to prevent suppuration by leeches and the application of cold belladonna compresses to the part; subsequently, if suppuration appears inevitable, hot poultices should be applied and changed every two hours. It will generally be advisable to administer morphia to allay the constitutional irritation, and the usual diaphoretic mixture may be given if febrile symptoms are present. The earlier an abscess in this situation is opened antiseptically the better: a free incision must therefore be made in the gland, as soon as fluctuation can be detected, and a drainage tube introduced. *Treatment.* Leeches and cold. Poultices. Opium. Incision.

HYPERTROPHY OF THE LACHRYMAL GLAND is an affection almost peculiar to young people. Probably one of the first symptoms of which the patient complains is a certain amount of double vision caused by the enlarged gland displacing the eyeball. On examination, the hypertrophied gland, which may grow to a considerable size, will be felt behind the outer part of the upper eyelid, and might be mistaken for a node or a sarcoma growing from the periosteum of the orbit, but it is painless, nodular, and increases in bulk with remarkable slowness. In the course of time the glandular swelling may gradually disappear, or it may suppurate, and a chronic abscess result, the discharge from which frequently lasts for months, causing the patient much annoyance, but little or no pain. Hypertrophy. Scrofulous. Double vision. Slow and painless growth. May suppurate.

In treating cases of hypertrophy of the lachrymal gland we must depend chiefly upon good food, fresh air, cod liver oil, and the iodide of iron, in the hope of promoting the absorption of the tumour. Cases arise in which it may seem advisable to excise Iodide of iron. Cod-liver oil.

the gland. If suppuration should occur, we must open the abscess as soon as possible.

CANCEROUS GROWTHS.—This gland is occasionally affected by sarcomatous or carcinomatous growths. The former is characterized by more or less displacement of the eyeball downwards and backwards, and after a time the enlarged gland may be distinctly felt behind the outer part of the upper lid; its growth is painless and usually slow. Should carcinomatous disease become developed in this situation, we shall, in addition to the above symptoms, have those superadded which are common to malignant disease in other parts of the body.

Cancer.

Question of removal.

The observations I formerly made regarding the advisability of removing scirrhus from the orbit, are equally applicable to malignant disease of the lachrymal gland.

LACHRYMAL CYSTS.

LACHRYMAL CYSTS (Dacryops) commence as small tumours in the upper and outer part of the eyelid, extending backwards, beneath the border of the orbit, towards the lachrymal gland.

Appearance.

"If the lid be drawn upwards, and pressure be simultaneously applied in a downward and inward direction, a tense, elastic, fluctuating swelling instantly starts out between the eyeball and the inner surface of the eyelid."* As the tumour increases in size, the movements of the eye become restricted, and it may even cause exophthalmos. If the patient strains, such as by crying, the tumour suddenly enlarges; this is a characteristic feature of the affection.

Impede the eye.

Arise from obstructed ducts.

This rare form of disease, as Mr. Hulke states, depends for the most part upon obstruction of one or more of the lachrymal ducts, in consequence of a neglected abscess or wound of the eyelid. The tears, being prevented from escaping, collect behind the point of stricture and cause the dilatation of the duct above described.

To be opened from within.

*Treatment.*—A permanent opening must be made into the cyst from the inner surface of the eyelid, the tears can then pass away over the eye. If the opening is made externally through the skin of the eyelid, a troublesome fistula may result.

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* Mr. J. W. Hulke on Dacryops Fistulosus: *Oph. Hosp. Reports*, vol. i. p. 285.

FISTULÆ OF THE LACHRYMAL GLAND occasionally form as the result of an abscess or injury. A fistulous opening leading to the lachrymal gland having formed, it may be in the skin of the upper eyelid, a clear fluid constantly drains away through it over the skin, and a probe may be passed through the fistula in the direction of the lachrymal gland. In a case of this kind it is advisable to pass a probe along the course of the fistula, and then, having everted the eyelid, to cut down through the conjunctiva on to the probe, and in this way create another fistulous opening on the palpebral conjunctiva, so as to conduct the lachrymal secretion to its proper destination. The galvanic cautery should then be applied to the mouth of the fistulous opening on the outer surface of the eyelid, in the hope that the inflammatory action thus excited may, on the separation of the slough caused by the cautery, close the external fistula. All other means of treatment having failed, it may be necessary to excise the lachrymal gland in order to cure the fistula.

Fistulæ.

Open from within.

Cauterize the mouth.

*Excision of the Lachrymal Gland* is thus performed :—A transverse incision of three-fourths of an inch in length should be made into the orbit, over the upper and outer third of the orbital ridge ; the external commissure of the lids may then be divided ; and by connecting the outer ends of the two incisions a triangular flap is formed, which is thrown up. The lachrymal gland is thus exposed, secured by a sharp hook, drawn forwards, and removed. The edges of the wound are then united by sutures. The linear scar of the incision is subsequently inappreciable, being lost in the folds of the upper eyelid.

Excision of lachrymal gland. Operation.

If the eyeball has been forced from its socket by the morbid growth, a pad should be applied over the lids subsequently to the operation, so as to retain the globe in its natural position till the tissues around it have retracted to their normal condition.

## CHAPTER IV.

## DISEASES OF THE EYELIDS.

*Wounds and Injuries—Inflammation—Ulceration—Tumours—Paralysis—Spasm—Abnormal position of Eyelids and Eyelashes—Entropium—Ectropium—Trichiasis—Adhesions—Œdema—Emphysema—Styes—Tinea ciliaris—Lice—Herpes—Chrom-hydrosis.*

### WOUNDS AND INJURIES.

Contusions. A "black eye."

CONTUSIONS OF THE EYELIDS.—A blow on the edge of the orbit or eyelids is apt to be followed by considerable swelling and ecchymosis of the part, a "black eye" being the result. We are frequently consulted in such cases, in order, if possible, to prevent the disfigurement caused by a bruise in this conspicuous part of the face. If the patient applies to us soon after the injury has been inflicted, and before any considerable amount of blood has become effused into the loose cellular tissue of the part, we may generally prevent any further ecchymosis by the application of a piece of lint soaked in a mixture of tincture of arnica and water (one part of the former to eight of the latter), which should be kept constantly applied to the eye; "it promotes the absorption of effused blood, prevents discoloration, and relieves pain and stiffness;"* or a solution of muriate of ammonia, acetate of lead, or ice may be used in the same way.

*Treatment.*

Arnica.

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* "Elements of Materia Medica," by W. Frazer, 2nd edit., p. 278.

Ecchymosis of the eyelids may be the effect of a far more serious injury, and becomes an important indication in cases of blows on the head, where one or more of the bones of the orbit have been fractured (p. 45). Ecchymosis of the lids in fracture of the skull.

WOUNDS OF THE EYELIDS.—In simple incised wounds of the lids, the edges of the wound must be brought into apposition with one or more horse-hair or fine silk sutures, and cold-water dressing subsequently applied. The sutures may be removed after two or three days ; but until then it is advisable to close the lids with a compress and bandage, the parts being kept at rest. If the wound has been inflicted for some days it is advisable to freshen its edges so as to enable them to unite without suppuration. I need hardly say that an apparently simple cut in the eyelid may be only the external indication of a wound which has penetrated deeply into the orbit ; nor need I repeat the caution already given against a too hasty and favourable prognosis in such cases (p. 46). Wounds. Simple. Sutures required. May mark a deeper injury.

Incised wounds of the eyelids, by dividing the fibres of the levator palpebræ, may destroy the action of the muscle, and render it impossible for the patient to raise the eyelid. In some few cases injury to the lids or supra-orbital region, either from a contused or incised wound, has been followed by paralysis of the levator palpebræ. In other cases, not only has ptosis come on, but this has been followed by gradual loss of sight. In order to explain this connection, we may presume that some of the branches of the fifth nerve have been injured, that the irritation has extended thence to the ophthalmic ganglion and carotid plexus, and ultimately involved the sympathetic in the morbid action ; a permanently engorged state of the capillaries being thus induced, which interferes with the nutrition of the nervous elements, these become atrophied, and the result is the condition above noticed. However this may be, it is well to bear in mind the fact, that even apparently trivial injuries to the eyelids are sometimes followed by paralysis of the levator palpebræ, or by total loss of sight in the injured eye. Instances of this kind are not to be confounded with those depending upon detachment of the retina, consequent on a blow or fall on the eye ; in these cases the loss of sight occurs immediately after the accident, May cause ptosis and loss of sight, from injury to 5th nerve.

and the ophthalmoscope will enable us to detect the nature of the injury.

Lacerated wounds,

In the case of lacerated wounds of the eyelids, there may be a little more difficulty in adapting the torn edges of the wound to one another. Having previously been cleaned from foreign substances or clots of blood, they should be brought as accurately together as possible, and retained there by means of sutures, otherwise an ugly scar may result, or a cicatrix of considerable extent, which by subsequent contraction may evert the lid to a greater or less extent. Occasionally, from inattention to these apparently trivial matters, the edges of the wound do not unite, and a slit or button-hole opening through the lid remains.

require care.

Burns.

Burns.—The eyelids are sometimes damaged by scalding water, by fire, the explosion of gunpowder, or other combustible material. Our chief care under these circumstances must be to prevent the formation and contraction of a cicatrix, which is certain to occur unless the greatest care be taken in dressing the wound. A piece of lint soaked in oil should be applied over the injured lid, together with a compress and bandage, so as to keep the lids well stretched over the globe of the eye until the wound has healed. It will be well especially to avoid rubbing or daubing the surface of such a wound with a sponge or wet rag: simply changing the dressing night and morning, and reapplying the pad and bandage will be quite sufficient.

Mischief from cicatrices.

Method of dressing.

Supposing, however, that loss of substance has occurred, the skin can only heal by granulation; and in such a case very careful and free skin-grafting should be practised; in this way we may prevent the formation of a cicatrix, or at any rate very much lessen its size.

Adhesions between the lids;

Should the edges of the lids be excoriated, they are very apt to grow together, particularly at their inner and outer angles; under these conditions the eye must be opened frequently, and the lids separated from one another as far as possible, so as to break down any adhesions that may have formed; the margins of the eyelids must be smeared with vaseline, or any similar substance, not likely to excite irritation, but which will prevent the raw edges of the lids from remaining in contact.

How prevented.

## INFLAMMATION OF THE EYELIDS.

ERYSIPELAS.—The skin of the lids is liable to be attacked by phlegmonous or erysipelatous inflammation, the latter usually extending from the parts around, and not uncommonly following exposure to cold, or suppuration of the lachrymal sac. ERYSIPELAS OF THE LIDS.

In these cases the lids become red, swollen, and tense; vesicles form on the inflamed surface of the skin, and bursting, give exit to a sero-purulent fluid. The patient complains of a tingling, burning feeling in the part, but seldom of deep pain, unless the cellular tissue of the orbit is affected; he is feverish, his tongue is foul, and the pulse usually feeble. In the majority of instances, the inflammatory action soon subsides and the parts return to their normal condition; but in severe cases the disease extends backwards to the orbit, and may, as I have before described, induce blindness by involving the optic nerve; under any circumstances, in bad or neglected cases of erysipelas, the cellular tissue of the lids slough and comes away in shreds, damaging the muscular apparatus of the lid, it may be destroying a considerable portion of the skin, giving rise to ectropium. Redness, Swelling, Vesicles. Pain. May cause sloughing.

*Treatment.*—In erysipelatous inflammation of the lids, it is advisable to paint the skin over with a solution of nitrate of silver (ʒj to an ounce of water) in the early stages of the disease. This application should extend beyond the limit of the inflamed skin, so as if possible to prevent the diseased action from extending; cold compresses may subsequently be applied. If suppuration has occurred, the skin and cellular tissue of the lids must be freely incised, and subsequently poultices applied, the integument surrounding the affected part having been painted over in the first instance with the tincture of muriate of iron. This drug should also be administered internally, together with stimulants and beef tea, as described in instances of erysipelas of the cellular tissue of the orbit. *Treatment.* Nitrate of silver. Incisions. Tinct. ferri. Stimulants.

SYPHILITIC ULCERATION of the eyelids may be the effect of acquired or of hereditary syphilis. The diseased action in the former class of cases usually commences in the conjunctiva, the virus having been directly applied to the part; from this point SYPHILITIC ULCERATION.

Primary chancre.

the chancre gradually invades the skin, and in fact the whole thickness of the lids.

Secondary.

Syphilitic ulceration of the eyelids is, however, more commonly a secondary affection. I have seen many instances of the kind especially of gumma, which had not been recognized as syphilitic until a considerable portion of the lid had been destroyed. Under these circumstances the ulceration usually commences at the margin of the lids: at first the skin only is involved, but in the course of time the tarsal cartilage and other structures are affected, so that the whole thickness of the lid is implicated in the ulcerative process; the edges of the wound become everted and thickened, and there is a constant discharge of bloody matter from its surface.

Extends to whole of eyelids.

Progress slow,

with few exceptions.

The patient seldom complains of much pain in the part, the progress of the affection being generally very slow; but should the individual be in a weak and emaciated state of health on the invasion of the disease, it may then make rapid strides, speedily involving the entire eyelid, and causing great suffering. In some cases the ulceration is comparatively superficial, the skin alone being affected; in these instances, the course which the disease takes is generally protracted, and often almost painless. In cases, therefore, where a patient has been suffering from ulceration of the eyelids, be careful to elicit any history leading to suspicions of a syphilitic taint.

*Treatment.*

Mercury at discretion.

*Treatment.*—Whether depending upon primary or secondary syphilis, the best method of treating these cases is by mercury, judiciously and cautiously administered. But it is sometimes necessary to abstain from specific treatment in the first instance, if the patient is in weak health. When, however, the patient is in a fit condition to be put under mercurial treatment, the hydrarg. c. creta, combined with soda and quinine, ought to be prescribed; its action being carefully watched, and the mercury discontinued on the first indication that the system has become affected. In many respects mercurial vapour baths afford a preferable method of administering the drug; but as they sometimes tend to exhaust the system, by the increased action of the skin which they occasion, this is an objection to their use where the patient has been previously in a feeble state

Mercurial vapour baths.

of health. Under these circumstances we may conveniently order the mercurial ointment to be rubbed into the patient's arm-pits and thighs night and morning, until the ulcer on the eyelids assumes a healthy appearance, which will usually be the case before the constitutional effects of the drug are apparent.

Local applications.

Probably one of the most suitable local applications we can employ for these ulcers is iodoform. Blackwash is often useful, or an ointment composed of ten grains of sulphate of copper to an ounce of simple ointment.

Ulcers from inherited syphilis.

Infants, the offspring of syphilitic parents, sometimes suffer from pustular eruption about the corners of the mouth and eyelids, as well as the anus; the pustules burst, and a scab forms, beneath which an indolent ulcer appears. These children are usually little, puny, wizen-faced creatures; their best chance is in a good healthy wet-nurse; and very mild inunctions of mercurial ointment. The effects of the medicine on the system may be estimated by the amelioration which takes place in the condition of the sores; directly the ulcers begin to improve the ointment should be lessened, but the action of the drug on the system must be prolonged for a considerable period after the ulcers have all healed.

Herpes of the Eyelids.

Herpes Zoster.—The skin of the lids, like that of other parts of the body, is sometimes affected with impetigo, leprosy, vitiligo, eczema, and herpes. These require no special notice, except perhaps the last, in which the deeper structures of the eye itself are sometimes affected.

Distinguished from erysipelas.

Herpes zoster is not uncommonly mistaken for erysipelas of the eyelids. Herpes frontalis, however, is always confined to one side of the median line, the eruption appearing only over that portion of the skin which is supplied by the ophthalmic division of the fifth nerve; the vesicles never form, therefore, over the patient's cheek. The pustules are small and numerous; they often, however, become confluent, and their contents dry up into a scab, which subsequently falls off, leaving a scar very much like that seen after small-pox. There is less constitutional disturbancein herpes than in erysipelas. On the other hand, the patient is affected with a peculiar numbness, mingled with pain which is often very severe, and precedes the eruption,

the heightened sensibility continuing long after the inflammatory outburst, and not passing beyond the median line. The nerves of sensation appear to play an important part in herpes zoster ; the peripheral distribution of the fifth, from cold or some such cause, becomes inflamed, and "the eruption succeeds as the result of an extension of the vascular excitement of the cutaneous tissues anatomically related to this network."

Pain relieved by atropine.

The intolerable pain in these cases is perhaps best relieved by a subcutaneous injection of atropine or morphia. The extract of belladonna and sulphate of quinine may be administered internally, and the acetate of lead lotion applied over the inflamed portion of the skin. In some cases, however, these means fail to remove the pain, and it has even been recommended to divide one or more branches of the nerve, a method of treatment I have certainly never had to practise in cases of this kind.

The iris sometimes affected.

If the forehead only is affected, although there will be eruption on the upper eyelid, yet the eye will not suffer. If the eruption appears on the upper part of the nose, there will be slight iritis ; while if the tip of the nose is affected, the eye will suffer severely. These differences are explained by reference to the anatomical distribution of the ophthalmic division of the fifth nerve, by which the disease is localized. The branch which supplies the tip of the nose is the one which supplies also the ophthalmic ganglion, and through it the structures of the eye.* After the acute symptoms of the disease have passed away, dark brownish scars frequently remain to mark the site of the eruption ; their colour subsequently fades into that of the skin around them, but the scars themselves remain like those of small-pox, during the remainder of the patient's life.

Limitation to nerve districts.

CHROM-HYDROSIS.

CHROM-HYDROSIS consists in the supposed excretion of an indigo-blue material from the surface of the eyelids. The colouring matter is easily removed by oil or glycerine, but not

* *Medical Times and Gazette*, Oct. 19, 1867, p. 432 ; see also remarks and cases by Mr. Bowman, *Oph. Hosp. Reports*, vol. vi. p. 1, 1867.

by water. The disease mostly occurs among women whose menstruation happens to be disordered, and their general health more or less impaired. In hysterical subjects.

A remarkable case of this kind is related by Warlomont,* which was made the subject of most careful investigation, and every means taken to prevent the practice of any deception on the part of the patient; still, the case is hardly satisfactory, and cannot be regarded as affording unequivocal evidence of the existence of this most singular disease, and doubts still exist on the matter. Most surgeons are of opinion, and I certainly agree with them, that chrom-hydrosis is generally a trick or invention of hysterical patients, the colouring matter having been applied by their own hands, not being excreted from the skin of the eyelids. Authentic case.

XANTHELASMA PALPEBRARUM.—These buff or yellow patches, not very unfrequently seen near the inner angles of the eyelids, give the patient considerable uneasiness on account of their appearance. The subject has for some time past engaged the attention of Mr. Hutchinson. He has arrived at the conclusion:— XANTHELASMA PALPEBRARUM.

That xanthelasma never occurs in children; whilst it is fairly common in middle and senile periods of life. Mr. Hutchinson's observations.

That in a small proportion of very severe cases, jaundice, with great enlargement of the liver, is met with.

The form of jaundice is peculiar, the skin becoming of an olive-brown, or almost black tint, rather than yellow, and the colour being remarkable for its long persistence.

In many cases in which there has been no jaundice, there is yet the history of frequent and severe attacks of functional disturbance of the liver.

Xanthelasma occurs more frequently in females than in males, the proportion being two to one.

In all cases the xanthelasmic patches appear in the eyelids first; and not in more than about 8 per cent. do they ever extend to other parts.

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* *Ophthalmic Review*, vol. ii. p. 179.

The patches invariably begin near the *inner* canthus, and almost invariably on the *left* side.

It is probable that of the causes mentioned, under which the pigmentation of the eyelids may be disturbed, disorder of the liver is the most powerful; hence the fact that the more extensive cases are usually associated with hepatic disease.*

## TUMOURS OF THE EYELIDS.

Epithelioma.

EPITHELIOMA.—The lower lid seems to be peculiarly susceptible to this form of disease; it seldom appears before an individual has reached the age of forty, and may commence as a

A wart at first.

small hard flattened lump on the edge of the eyelid near the caruncle, gradually extending to the lower lid. This thickened tissue is due to an abnormal growth of the epithelial cells; these cells are generally flat and packed closely together. Each cell has a large oval nucleus and several nucleoli. The cells form irregular cylindrical processes, which in thin sections are cut in a variety of directions, giving the idea of nests of cells. Between these cylinders is a fine fibrous tissue with vessels. At first the affection appears so insignificant, and so closely resembles an ordinary wart, that probably little notice is taken of it. After a time, however, the pimple or wart-like growth ulcerates, and a

Subsequent ulcerations. Advance slow.

small indolent sore, with raised edges and a glassy-looking surface, appears. The disease advances slowly, and the original sores often appear for a time to have healed, a thin cicatrix forming over them, but which is soon broken through by the exudation of a serous fluid from an open ulcerated surface. The diseased action extends itself by the well-known cylinders

Little pain.

of epithelial cells deep into the corium; it is not always attended with pain, but a tingling, itching feeling exists in the part. The

Extends in depth and breadth.

disease spreads, gradually involving the lower lid and skin of the cheek in a mass of ulceration, from the surface of which there is a constant sanious discharge, and at the same time the lymphatic glands in the parotid space may become enlarged.

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* *Lancet*, vol. i. 1871, p. 410.

The ulcers in their early stages often appear dotted over with a number of little granules, in appearance like millet seeds, or pearl-nodule collections. It is important to make a correct diagnosis in cases of this description, for epithelial cancer, situated in any accessible part of the body, may be effectually cured, if completely extirpated by means of the knife in its early stages. Epithelioma might be mistaken for syphilitic, lupoid, or rodent ulceration; the two former are amenable in their early stages to medical treatment; the latter, like epithelial cancer, can alone be cured by removing the whole of the diseased structures with the knife. Diagnosis most important.

In the more advanced stages of epithelioma—in fact, when the whole of the eyelid and part of the cheek have become a mass of disease, it may still be advisable to remove the abnormal growth, applying a strong solution of chloride of zinc to the surface of the wound. Apparently hopeless cases are recorded, in which this practice has been followed by satisfactory results. Later removal.

If the disease is allowed to run its course, the patient must inevitably sink under it.

*Rodent Ulcer* more frequently commences in the skin of the lower lids than along the edge of the eyelid; the disease begins as a dry wart, and after the excrescence has been shed several times the skin ulcerates. The ulcer has a hard base and edge; it spreads with characteristic slowness, eroding the neighbouring structures; the surface of the sore is devoid of granulations, and glazed. There is very little discharge from the ulcer unless it happens to become inflamed. Rodent ulcer seldom appears until after an individual is forty-five years of age. The disease must be entirely removed by means of the knife, and the surface of the wound subsequently smeared over with the chloride of zinc, so as, if possible, to destroy the whole of the morbid growth. Rodent ulcer.

*Lupus* as a rule occurs earlier in life than rodent ulcer; it has more inflammation and much less hardness, and is often accompanied by lupus elsewhere on the cutaneous or mucous surfaces.

WARTS not unfrequently grow from the skin of the lid, and WARTS.

if near its free margin, they may press upon, and bend some of the cilia inwards against the eyeball. The sooner, therefore, a wart so situated is removed the better ; it is useless to waste time in applying caustic, it should be snipped off with a pair of scissors.

Remove at once.

Horny growths.

HORNY EXCRESCENCES are now and then met with springing from the skin of the lids ; they seem to depend upon the secretion from a sebaceous gland becoming hardened, and fresh exudations taking place over it ; layer after layer of the sebaceous matter thus drying over the original deposit, the horn-like mass at length becomes of such a size as to disfigure and inconvenience the patient considerably.

Remove with scissors.

The same plan of treatment is to be adopted as in the case of a wart : the excrescence, and the skin from which it appears to grow, being snipped off with a pair of curved scissors.

Milium,

MILIUM.—Accumulations of sebaceous matter occasionally occur in the ducts of the subcutaneous glands, forming little tumours on the edge of the eyelids, resembling minute pearls, situated beneath the epidermis. They seldom exceed a pin's-head in size, and frequently form in groups of irregular shapes and dimensions. It is seldom necessary to interfere with minute tumours of this kind ; but if it is deemed advisable to do so, the epidermis covering them may be scratched with the point of a knife, and the contents of the cyst squeezed out.

unimportant.

Sebaceous Tumours, of small size.

SEBACEOUS TUMOURS, only slightly larger than those last described, but which may grow to the size of a split pea, and contain sebaceous matter, are occasionally met with in the skin of the lids. They may be readily removed by carefully incising the skin over them, and then squeezing the cyst and its contents out of its nidus. The walls of these cysts, however, are by no means thick, and are almost sure to burst in our efforts to remove them, in which case the remains of the cyst should be torn away from its attachments. If this is not done, the tumour is apt to appear again ; in fact, if left to Nature, the course they usually take is, after growing to a certain size, to burst and give exit to their contents, which speedily re-form so long as the cyst remains intact.

Destroy the cyst.

Larger tumours,

Large sebaceous tumours, similar to those noticed in other

parts of the body, sometimes form in the eyelids, most commonly springing from the periosteum of the frontal bone. They generally contain a glairy, fatty matter, and frequently also a number of hairs. Like the other forms of cystic tumours, they give the patient no pain or inconvenience, beyond such as arises, in this particular situation, from their bulk, which is often considerable. painless but bulky,

In excising a tumour of this kind it is well to make the incision from without inwards, or in a direction parallel to the fibres of the orbicularis, as the morbid growth is usually situated beneath this muscle. The entire cyst must as far as practicable be removed, and it will much facilitate the operation if this is accomplished without opening it. There is then every chance of the wound healing by the first intention, a slight scar only remaining to indicate the position of the incision. should be excised.

MEIBOMIAN CYST, CHALAZION, OR TUMOR TARSI.—These tumours arise in the follicles of the Meibomian glands, and are therefore imbedded in the substance of the tarsal cartilage. As they increase in size, they form little painless swellings beneath the skin of the lid, varying in size from a split-pea to a horse-bean. They are unsightly, and induce a disagreeable stiffness of the lids, but beyond this are harmless. On everting the lid from which they spring, the position of the tumour is marked by a circumscribed, yellowish-white projection (*see* Fig. 14). MEIBOMIAN CYSTS. Their characters.

FIG. 14.

These tumours sometimes become inflamed, and suppurate, without any apparent cause : the abscess, having discharged its contents, the parts return to their normal condition. But, in the majority of instances, it is advisable to evert the lid thoroughly, and the conjunctiva being put on the stretch, so as to render the tumour prominent, a crucial incision must be made into it through the conjunctiva, so that the tumour may be laid open, and its contents scraped out with a small spatula or curette. May suppurate. Should be opened.

Immediately after the operation the wound fills with blood,

and the size of the tumour may not perhaps appear to have diminished; but in the course of a few days the blood is re-absorbed, and all traces of the tumour disappear.

Water dressing.

There is no necessity for any after-treatment in a case of this kind. Cold-water dressing may be applied over the lids for twenty-four hours, the eyes being closed with a pad and bandage: otherwise the rough surface of the conjunctiva, rubbing against the cornea, may give the patient annoyance. It may subsequently be necessary to attend to the patient's general health, administering tonics, and otherwise endeavouring to improve the tone of his system; for these tumours are likely to follow one another in quick succession, both in the upper and lower eyelids, if the patient is below par.

Improve the general health.

Calcareous Concretions,

Calcareous Concretions may form in the ducts of the Meibomian glands, and can be felt as small nodulated lines beneath the skin of the eyelid. On everting the lid, the white deposits in the duct may generally be seen beneath the conjunctiva. These concretions give rise to a good deal of irritation by rubbing against the surface of the cornea, inducing hyperæmia of the conjunctiva, which cannot be cured till the foreign substance in the ducts is removed.

in gland ducts,

to be removed.

The plan of treatment in these cases is to evert the lid and slit open the duct, and then with a spatula or some such instrument, to scrape out its calcareous contents. These concretions are very apt to re-form, especially in districts where the drinking-water contains an unusual quantity of the salts of lime.

Fibroma.

Fibroma of the eyelids is occasionally met with as a small bony tumour, of very slow growth, but sometimes being exquisitely painful. A growth of this kind should be removed as soon as possible.

Nævi.

Nævi (*Teleangiectata*).—A nævus must necessarily be of comparatively small size if confined to the eyelids. For the most part they are of congenital origin, the muscular fibres covering them gradually become absorbed, and the nævus then appears as a soft and compressible tumour, situated under the skin, its colour depending upon the preponderance in it of the arterial or venous elements. The blood may readily be squeezed out of the nævus if slight pressure be exerted over its surface;

Deep colour.

but the sponge-like mass refills and swells up again, as soon as the compressing force is withdrawn. In like manner, a nævus becomes swollen and congested, if the patient strains to any extent, as in the act of coughing or crying. Sponge-like character.

*Treatment.*—Our object is to obliterate the vascular network, of which the nævus is constituted; but at the same time, if possible, to prevent the skin covering it from being destroyed. If this is not provided against, a cicatrix may form, which, in contracting, may evert the eyelid. A small nævus may often be destroyed by applying over its surface some strong nitric acid. In larger nævi I am in the habit of passing two or three worsted threads, soaked in perchloride of iron, through the base of the tumour, and leaving them there for a day or two—in fact, till they have excited some slight amount of inflammation, when they should be withdrawn. The inflammatory action thus set up is often sufficient to obliterate the vessels forming the nævus. *Treatment.* Spare the skin. Nitric acid. Worsted threads.

If the nævus is of some size, two fine pins should be inserted at right angles through the skin, beneath the nævus. Behind these pins a few turns of ligature silk should be twisted, so as to strangulate the nævus. As soon as the part begins to slough the needles may be removed. Electrolysis has of late been successfully employed for the cure of these nævi; its application is free from pain, and it leaves no scar or disfigurement. If large, treat by compression.

*Angiomata* of the eyelids may be pedunculated, but are more apt to have a broad base, though movable beneath the skin. Dr. C. S. Bull has shown that most of these vascular tumours of the lids are venous, and contained in a cyst wall. Tumours of this kind should be incised. Lid-clamp forceps must be applied, and the tumour may then be removed without loss of blood. If loss of skin results from the operation it may better be replaced by skin-grafting than by any form of plastic operation.

## PARALYSIS AND SPASM OF THE EYELIDS.

PTOSIS, OR FALLING OF THE EYELID.—An inability to raise the upper eyelid may occur in one or both eyes from any of the following causes: first, it may be a congenital defect; secondly, it Ptosis. Varieties.

may depend upon a relaxed state of the skin and tissues of the lids; thirdly, ptosis may arise from an injury to the levator palpebræ muscle; fourthly, it may occur from a defect in the nervous apparatus supplying that muscle.

Prevents vision.

From whatever cause arising, a patient suffering from ptosis is unable, by a voluntary effort, to raise the upper lid of the affected eye, but in other respects his vision, and in fact the ocular apparatus, may be perfect. If the ptosis is complete, the upper lid, by hanging over the cornea, obstructs the passage of light to the eye; and hence, for all practical purposes, the sight is destroyed till the obstruction is removed.

1. Congenital ptosis.

1. In congenital ptosis both eyelids are usually equally affected. For its relief, an elliptical portion of the skin of the

Excise a portion of skin.

lid may be removed, the edges of the wound being brought together with sutures, and the shortening of the lid thus produced may enable the patient to raise it sufficiently to admit the rays of light into the eye; but in many of these cases the muscular fibres of the levator palpebræ are almost entirely wanting, and in spite of the above described operation, the lid still droops over the pupil, interfering very much with the perfection of

Elongate the pupil.

vision. In a case of this description I lately elongated the pupil downwards to the great relief of the patient. Such cases may tax our ingenuity to the utmost in order to devise means for their amelioration; but, fortunately, this form of ptosis is rare.

2. Ptosis from relaxed tissues.

2. Ptosis, arising from an elongation of the skin and connective tissue of the lids, is a more manageable affection; it seldom occurs except among old people, or those who have suffered from long continued conjunctivitis. In these cases the connective tissue and skin have been stretched to cover the hypertrophied mucous membrane, while the fibres of the levator palpebræ have become atrophied from senile degeneration. The contractile power of the levator is seldom, however, completely destroyed; and considerable benefit, therefore, frequently arises

Excise a bit of skin.

from excising an elliptical portion of the skin, allowing the wound to cicatrize, and in contracting to shorten the lid. The state of the conjunctiva must also be attended to, for in the majority of these cases it is hypertrophied, and, in all proba-

bility, will be improved by the application of the dilute red mercurial ointment to its surface twice a day. Ung. hyd. rub.

3. Wounds and injuries of the levator palpebræ, by dividing or destroying the contractile power of the muscle, are likely to induce ptosis. We may endeavour to rectify this state of things by excising a portion of the skin of the lid; but the loss of power in the muscle will prove a serious obstacle to any permanent amendment. If, as is most probable in cases of this kind, only one eye is affected, it is advisable to elongate the pupil downwards, endeavouring by this means to restore binocular vision. 3. Ptosis from wounds.

4. Ptosis, arising from paralysis of the levator palpebræ, appears occasionally to be the result of an injury to one of the branches of the fifth nerve, probably affecting the motor nerve by reflex action from the quadrigeminal bodies. 4. Paralytic ptosis. Reflex.

The same result may follow malarious affections of the supra-orbital nerve. In these cases the optic nerve and recti muscles are more or less affected, and their functions impaired. Malarious.

In those more complicated cases, however, where the ptosis seems to depend on a primary affection of the third pair of nerves or nervous centre, we may have to exert all our intelligence and skill both in referring the malady to its true cause, and adapting our remedies to the special requirements of the case. We shall do well to bear in mind that syphilis in its various phases is a prolific source of disease of this kind, both in the sheaths of the nerves and in the brain itself; nor must we forget that this form of ptosis may be due to tumours, to limited apoplexy, and many other obscure affections to which the nervous centres are liable. Syphilitic and other obscure forms.

In some instances, paralysis of the levator palpebræ is developed suddenly, apparently from the effects of cold. The patient has probably been exposed to a bleak wind, or slept in a damp bed, and the next morning on rising, finds that he cannot raise one or other of his eyelids. Many of these cases undoubtedly recover, and if the patient is otherwise in good health, my prognosis is generally favourable, but it may take several months before the muscle regains its power. In some instances progressive atrophy of the optic nerve supervenes: under these Ptosis, apparently from cold,

due to degeneration of the nerves or brain.

circumstances it is more than probable that the disease, though attributed to cold or rheumatism, has been in progress for a considerable time, and depends either upon embolism of some of the smaller vessels, or fatty changes in the central axis of the nerve, or nervous centre.

*Treatment.*

In the earlier stages of ptosis, if of malarious origin, we must not neglect the use of drugs ; and we may reasonably hope to stop the further progress of the local affection. With this intention we should try the effect of arsenic combined with iron and strychnine, and other reputed remedies for the cure of malaria.

Drugs.

Blisters, Pot. iod.

We may also employ counter-irritation by an issue, or blisters to the temples, as well as administer nervine tonics, iodide of potassium, and so forth, according to circumstances, not neglecting due attention to the condition of the alimentary canal and its secretions.

In other cases of ptosis, depending for instance on cerebral disease, the wasted muscle may be best excited by means of Faradization.

Faradization.

In employing electro-magnetism for the relief of ptosis, the positive pole may be applied below the ear, and a small piece of moist sponge, connected with the negative pole, over the skin of the closed eyelid. The excitation should be weak, and never continued for more than a few minutes at each sitting. If this mode of treatment is likely to prove beneficial, the amendment generally becomes apparent very speedily. Unfortunately, this form of paralysis is often slow in its development, and being attended by no urgent symptoms, the patient may fail to apply for relief until irreparable damage has been done to the muscles.

PARALYSIS OF THE ORBICULARIS. Prevents closure of the lids.

PARALYSIS OF THE ORBICULARIS PALPEBRARUM is less frequently met with than ptosis. When it exists, the patient may be able to open the affected eyelid, but is unable to close it completely ; and the cornea, being more or less constantly exposed, particles of dust settle upon it, it becomes irritated, and ulceration is apt to occur. The orbicularis is seldom paralyzed alone ; in almost all cases the other muscles of the same side of the face, supplied by the seventh nerve, are also affected, the sensation of the part remaining perfect.

Cornea suffers.

The most common causes of this "Bell's palsy," as it is called, are exposure to cold, mental emotions of various kinds, and traumatic lesions of the nerve; the paralysis occurs suddenly. In other cases the affection depends on some syphilitic affection of the facial nerve, or of the bony wall of the aqueductus Fallopii; it may be due to otitis, terminating in necrosis of the petrous portion of the temporal bone. Cold, a cause. Syphilis.

In some few instances the paralysis is of central origin. M. Trousseau, in referring to such cases, remarks, that the "orbicularis palpebrarum is never paralyzed to the same extent in lesions of the hemispheres of the brain, as it is in disease of the facial nerve: hence, if a hemiplegic patient is asked to shut his eyes, he does it completely enough to hide the globe of the eye, whilst the eyeball remains uncovered in cases of paralysis of the seventh pair."* The pathology of facial paralysis, however, is an extensive subject, and I can only glance at those points in its history which have a direct bearing on the questions before us. Disease of brain.

As I have already said, the orbicularis is often involved in facial palsy: consecutive ulceration of the cornea is very apt to occur, and the eye may thus be destroyed; and consequently it is advisable, under these circumstances, to keep the eye closed with a pad and bandage until the orbicularis has regained its power. Troublesome lachrymation is present from an early stage of the affection, the lower lid no longer forms a canal for the tears; the puncta, moreover, in consequence of the paralysis of the orbicularis, cannot assume their normal position, but drop away from the eyeball, leaving the tears to trickle down over the corner of the eye. Very many cases of facial paralysis recover of themselves; perhaps one of the best tests we possess of the probable result of a case, is to ascertain how the affected muscle responds to the electro-magnetic current. If no contraction of the palsied muscle takes place on being thus stimulated, it is almost a certain sign of the incurable nature of the disease. Ulceration of the cornea. Lachrymation. Electricity an aid to prognosis.

Although facial paralysis frequently gets well of itself, the *Treatment.*

* Bazire's translation of Trousseau's "Clinical Medicine," vol. i. p. 3.

cure may be sometimes hastened by counter-irritation, and exhibition of strychnine, veratrium, and the use of Faradization. In instances of a syphilitic, or apparently malarious origin, while employing electricity to excite the muscle into action, we should never fail to administer iodide of potassium, quinine, and other drugs, which appear sometimes to exercise a direct influence on these affections.

BLEPHAROSPASMUS.

BLEPHAROSPASMUS, or spasmodic closure of the eyelids, is an affection of the orbicularis. This muscle is especially liable to spasmodic disorders, the levator palpebræ being but rarely affected.

1. Clonic form. Nervous winking.

In certain cases of spasm of the eyelids, the contractions are of a clonic kind, so that the patient is constantly winking; or if a portion only of the muscle is involved, a limited twitching is produced. This affection is most common among weak and irritable subjects, and, though unpleasant enough, is generally of no great moment, being readily overcome by a tonic plan of treatment, and the use of a stimulating liniment. There are cases, however, in which such clonic contractions of the lids become a permanent disorder, and these are more troublesome to friends than to the patient himself, who becomes unconscious of, or indifferent, to them.

2. Tonic spasm.

A far more serious form of blepharospasm is that in which the contractions are of a tonic kind, and either intermittent or continuous. Even when intermittent, the disease is frequently most distressing, and attended with absolute danger to the patient; for he may be seized with a violent spasm of the lids at any moment, entirely destroying his sight for the time; and supposing that he happens to be crossing a crowded street at this particular moment, he runs a risk of being thrown down and run over. Moreover, the affection is in other respects a most painful one, interfering as it does with work, and rendering the patient unfit for all useful employment.

A source of danger,

and disabling.

*Causes.*—Blepharospasm often depends upon irritation reflected from the sensitive to the motor nerve. M. Wecker describes this affection under three heads, according to the source of the irritation:—Firstly, the traumatic; secondly, that depending on disease of the cornea or conjunctiva; and

Reflected irritation.

thirdly, upon an affection involving all the branches of the facial nerve.

In the first class of cases, the spasm is generally determined by the presence of a foreign body on the cornea or conjunctiva, the irritation of the branches of the fifth nerve, which is thus produced, being reflected through the seventh or motor nerve to the muscles it supplies. At first the spasm is intermittent, and confined to the orbicularis; but eventually it becomes continuous, and may spread to all the muscles of the face, especially if an attempt be made to open the eyelids by force. At first, perhaps, one eye only is affected, but the other may subsequently become involved. 1. From foreign bodies.

In the second class of cases, the blepharospasm may be caused by the irritation arising from pustular conjunctivitis, or an ulcer of the cornea. The abnormal reflex action thus established, may persist even after the cause of it is removed. To this class we must refer the spasmodic closure of the eyelids in so-called strumous ophthalmia. 2. Pustular conjunctivitis.

The third class includes cases of neuralgic tic of the face, in which the morbid condition of the fifth nerve, especially its supra-orbital branch, is propagated by reflex action to the seventh pair, causing spasm of the orbicularis. Malaria, rheumatism, sudden exposure to cold, irritation of the nerve by bony growths in its passage through the skull, or faulty digestion, may be mentioned as some of the most common causes of this form of blepharospasm. 3. Neuralgic.

*The Treatment* will of course depend upon the nature of the disease. If the spasm is caused by the presence of a foreign body in the eye, the offending particle must be removed as soon as possible; and so with affections of the conjunctiva, we must endeavour to cure the local disease. But in the third class of cases, we should try to ascertain which of the branches of the fifth nerve is principally involved, and, as a guide to its discovery, we may exert pressure at different points of the surface—for example, over the exit of the supra-orbital nerve, and notice if it influences the spasm of the lid; or, again, we may examine in the same way the inferior dental nerve at the dental foramen. If we can thus discover the point of departure of the *Treatment.* Remove local cause. Divide sentient nerve,

irritation among the branches of the fifth, we may very probably, by division of the nerve, interrupt the chain of nervous actions on which the spasm of the orbicularis depends. It may be necessary to divide the nerves on both sides of the face: and at first the beneficial effect of the operation may not be very apparent, but gradually the spasm passes off, to the great relief of the patient. Unfortunately, after an apparent cure has been effected in this way, the disease will sometimes return.

on one or both sides

Faradization.

Morphia.

Among other remedies which may be usefully employed for the relief of blepharospasm, are electricity, the continuous current being used; and also the subcutaneous injection of morphia. These should always be tried before we have recourse to surgical interference. The injection should be made, in the first instance, over the branches of the supra-orbital nerve.

Extraction of teeth.

Dissection of cicatrices.

We should never omit to make a careful inspection of the teeth in this form of disease; for the extraction of a carious tooth may remove the blepharospasm. In like manner, the cicatricial tissue of a wound, involving branches of the fifth nerve, may have to be dissected out to relieve the irritation it occasions in the sentient fibres. In fact, careful consideration, and a judicious adaptation of remedies will be called for, to enable us to comprehend and successfully meet the various forms of this very troublesome complaint.

Habit.

Some cases of blepharospasm are due simply to a bad habit acquired unconsciously by the patient; such cases are relieved, and I have seen them cured, by keeping the eye which is not affected closed, obliging the patient in this way to exercise the eye surrounded by the spasmodically affected muscles; these find a necessity for rest and normal action, and so learn to behave themselves.

## MALPOSITIONS OF THE EYELIDS AND EYELASHES.

Entropium.

ENTROPIUM, or an incurving of the margin of the eyelids, may be partial or complete, and may be conveniently divided into two classes—the spasmodic, and permanent.

1. Spasmodic.

The first is seldom met with except amongst old people

whose skin has become lax and wrinkled. We occasionally see cases of the kind resulting from the application of a compress and bandage, as after the operation of extraction of the lens.

The lower lid is generally affected in instances of spasmodic entropium: its ciliary margin, being curved inwards on itself, carries the cilia with it, so that the latter cannot be seen unless the skin of the lid be retracted, when the cilia assume their normal position; the irregular contraction, however, of the fibres of the orbicularis soon causes the margin of the eyelid to become again incurved. There is not only a lax condition of the cutis in these cases, but the outer fibres of the orbicularis lose their contractile power; whereas those near the margin of the lid, acting with unusual force, turn the cilia inwards in the way described. The eyelashes, being thus brought into contact with the cornea, cause such an amount of irritation that pathological changes gradually take place in its structure, ending in vascular opacity, or, it may be, destructive ulceration.

Confined to lower lid.

Condition of the parts.

Irritation of the cornea.

*Treatment.*—Should the entropium have arisen from mechanical causes, as, for instance, from the pressure of a bandage over the eyelids after the extraction of a cataract, it is only necessary to remove the cause, and after a time the orbicularis will regain its functions, and the lid be restored to its normal position. This result may be hastened by first retracting the lid, and then applying a layer of collodion, or a strip of plaster, along its cutaneous surface, so as to keep the lid in its natural position; of late, the various kinds of adhesive plaster have been so much improved that we can select those uninfluenced by moisture. Strips of such plaster may be used with success to overcome the bad habit acquired by the orbicularis in these cases of spasmodic entropium.

Remove the cause.

Apply collodion or plaster.

In the more inveterate cases, whether depending on mechanical or other causes, it will be necessary to excise an elliptical portion of the skin and subcutaneous tissues, parallel to the free margin of the lid; when the contraction of the tissues as they cicatrize will, by shortening the external covering of the lid, retain the ciliary border in its normal position.

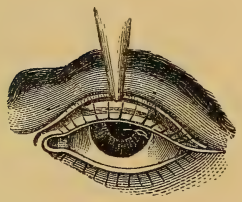
Excise a portion of skin.

A pair of entropium forceps should be used to pinch up

Operation.

a fold of the skin, running parallel to the ciliary margin of the lid, which may then be excised with curved scissors (*see* Fig. 15). The amount of skin to be removed will depend upon the extent of the entropium, and may be judged of by noticing if the fold seized between the blades of the forceps is sufficient to restore the cilia to their normal position. Care must be taken to avoid wounding the puncta; in fact, it is seldom advisable to remove the skin towards the inner angle of the eye; for although the punctum may not be wounded, it may be everted by the contraction of the cicatrix, and will thus inconvenience the patient, the tears not being able to escape through the puncta, a watery eye results.

FIG. 15.



Avoid the region of the puncta.

2. Permanent entropium, from granular conjunctivitis, or age.

*Permanent entropium* differs from the spasmodic form, in that the incurving of the lids depends upon changes in their structure, very often caused by granular conjunctivitis. It may also occur, among old people, from the eyeball sinking into the socket; the palpebral border of the orbicularis is then very apt to become inverted. The upper and lower lids are equally subject to this form of malposition, and one or both eyes may be affected.

As I have above remarked, in the majority of cases, permanent entropium results from the effects of granular conjunctivitis, which leads to the formation of cicatrices of the mucous and submucous tissues; these cicatrices in contracting, shorten the tarsal cartilage from side to side, as well as from above downwards, so that the ciliary margin of the affected lid is turned inwards, in consequence of the increase in the natural curvature of the cartilage. The lid affected in this way becomes shortened from side to side, and its mucous membrane is generally hypertrophied; it is evidently impossible, in the presence of so much structural change, to restore the cilia to their normal position by retracting the skin of the lid.

Cartilage shortened.

Curvature increased.

In permanent entropium the eyelashes are often destroyed, a

few irregular and distorted cilia alone remaining. These stumps, however, by constantly rubbing against the surface of the cornea, produce such an amount of irritation, that the transparency of the cornea is gradually lost. Cilia rub against cornea.

*The Treatment of Permanent Entropium* consists in either removing the cilia together with their bulbs, so as to prevent their rubbing against the cornea, or else excising a portion of the skin, and grooving the tarsal cartilage, so as to restore the margin of the lid to its normal position. *Treatment.* Remove or evert the eyelashes.

The excision of the cilia and their bulbs is to be managed as follows :—A pair of Desmarres' forceps having been applied to the lid, an incision is made through the skin and subcutaneous tissues, down to the tarsal cartilage, parallel to, and about one-eighth of an inch from the margin of the lid. The extremities of this cut are to be carried down to the free edge of the lid, and the small flap of skin, enclosed within the incisions thus made, is to be dissected away from the tarsal cartilage, together with the subcutaneous tissue and bulbs of the cilia. The wound must be carefully cleaned and examined for any remaining bulbs of the cilia, which should be removed. Cold-water dressing may then be applied till the wound has healed. Excision of cilia.

If it is not thought advisable to destroy the cilia, the following operation may be resorted to :—Desmarres' forceps having been adjusted to the lid, an incision is to be made through the skin and subcutaneous tissues, down to the tarsal cartilage, parallel to and about the sixth of an inch from its ciliary border, taking care to keep clear of the bulbs of the eyelashes. A second incision is to be made, of the same depth, parallel to the first, and about a quarter of an inch from it, and joining it at either extremity. These incisions are then to be deepened by cutting obliquely downwards into the tarsal cartilage, so as to form a groove in its substance, and the skin, subcutaneous tissue, and cartilage, contained within the above incisions, are to be dissected away. The object of this operation is, in fact, to cut an elongated, wedge-shaped piece out of the skin and tarsal cartilage, so that when the edges of the wound have united, the incurved palpebral margin of the lid will be everted, and resume its normal position. In this operation care must be taken not Operation for preserving the cilia. Grooving the tarsal cartilage.

to wound the puncta, or cause them to become everted by removing the integument about them.*

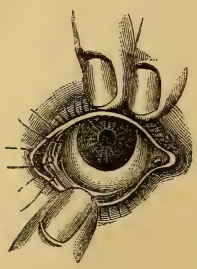
Shortening of the palpebral fissure.

As entropium is frequently complicated and augmented by a shortening of the tarsal cartilage from side to side, it necessarily follows that the longitudinal diameter of the palpebral fissure becomes lessened in these cases. It may be necessary to

Operation.

elongate the contracted fissure, by slitting up the outer commissure of the eye, as far as the orbital process of the malar bone. After dividing the external commissure, the edges of the wound must be fixed by means of sutures or strips of adhesive plaster to the integument of the forehead, and the lower to the cheek, so as to keep the lips of the incision apart, converting, in fact, the primary horizontal wound into a vertical one (Fig. 16). So long as these sutures can be retained, the edges of the incision evidently cannot unite; in practice, however, we find it very difficult to get our patients to submit to this treatment; the pain and inconvenience they endure is very great, and though, undoubtedly, the proceeding is most beneficial if it can be carried out, still it is desirable that some simpler means should be devised for attaining the same end. This may be very imperfectly accomplished by slitting up the commissure, and then uniting the conjunctival and cutaneous edges of the wound by means of sutures.

Fig. 16.



Practical objections.

Pagenstecher's method.

Pagenstecher, after dividing the external commissure, takes up a horizontal fold of skin and orbicularis muscle with a pair of forceps, and then passes several ligatures through the base of the fold, allowing them to ulcerate their way out through the skin; the cicatrices thus formed produce permanent eversion of the incurved lid. In passing the ligatures through the fold of skin, the point of the needle is to be entered close to the external

* Streatfeild, On Grooving the Fibro-Cartilage: *Ophthalmic Hospital Reports*, vol. i. p. 123.

surface of the tarsal cartilage, and brought out at the edge of the lid; the ligature is to be firmly tied, and allowed to suppurate out, which it generally does in six or eight days. Water-dressing may be applied subsequent to the operation.

ECTROPIUM, OR EVERSION OF THE EYELIDS, may be divided into three classes. 1st. Temporary eversion of the lids, depending usually on purulent conjunctivitis. 2nd. Ectropium arising from hypertrophy of the conjunctiva. 3rd. Ectropium from the contraction of a cicatrix, the skin of the lid having been destroyed either by an injury, or from disease. ECTROPIUM. Three varieties.

1. The first form of ectropium generally arises under the following circumstances:—In cases of purulent conjunctivitis, the mucous membrane may be so much swollen that the free margin of the lid is forced away from the eye, to such an extent as to become doubled back upon itself, in precisely the same way as if we had everted it for the purpose of examining the palpebral conjunctiva. Under these circumstances the fibres of the orbicularis, at the line of eversion of the lid, form a constricting band, which, by pressing on the vessels, impedes the circulation of blood through them, and the everted conjunctiva may in consequence slough, irreparable injury being done to the eye. Among young children suffering from purulent conjunctivitis, this form of ectropium is especially likely to occur, the lids having been everted, perhaps, in dropping some lotion into the eye, and no trouble taken to restore them at once to their natural position. 1. Temporary. From conjunctivitis. May cause sloughing. Frequent in children.

*The Treatment* of this form of eversion of the lids, consists in scarifying the swollen and everted conjunctiva, so as to empty its vessels of blood, after which a little gentle pressure on the swollen lid will reduce the œdema of the part, and the lid may then generally be returned to its natural position with ease, but in some cases may have to be retained there with a pad and bandage applied over the eye for twenty-four hours. The dressing should be removed from time to time, to enable us to clean the eye, and apply the necessary remedies for the cure of the conjunctivitis. *Treatment.* Scarification. Pad and bandage.

2. The second form of ectropium, arising from hypertrophy of 2. Chronic form.

the conjunctiva, is often thus produced :—Among aged people the skin of the lids becomes lax, and the puncta no longer fit closely against the globe, and the tears are retained in contact with the eye. The lacus lachrymalis being always full of tears, considerable irritation of the mucous membrane is excited, and chronic inflammation and hypertrophy of the conjunctiva are ultimately induced; the thickened mucous membrane then forces the lids away from the eye, and ectropium results. The eversion of the lid is usually augmented under these circumstances by inflammation and ulceration of the skin at the inner angle of the eye, caused by the irritation of the tears constantly flowing over it, and the efforts of the patient to keep the part dry.

From hypertrophy of conjunctiva.

Another cause of this form of ectropium—brought about, however, in precisely the same way—is a partial paralysis of the fibres of the orbicularis muscle : the lower lid droops away from the eye, the puncta are everted, and hypertrophy of the conjunctiva and ectropium follow.

From paralysis of orbicularis.

Eversion of the lid occasioned by chronic irritation and thickening of the mucous membrane, whether arising from the causes now mentioned or any other—as, for instance, tinea ciliaris — in course of time not only induces a permanent eversion of the tarsal cartilage, but also a lengthening of the lid from side to side. The exposed mucous membrane becomes converted into a thickened reddish mass, assuming very much the characters of the skin. The disease is, therefore, not only very unsightly, but since the patient is unable to close his eye, dust and dirt get lodged on the cornea, and these, together with the contact of the air, produce vascular opacity, and it may be destructive ulceration in the cornea, or even changes in the deeper structures of the eye.

Changes in the cartilage,

and cornea.

*Treatment.*—In the first instance, in slight cases, we may try the effects of the red precipitate ointment, applied twice a day over the ectropium and along the margin of the lids. If this does not succeed, the ectropium should be still further everted by traction on the neighbouring skin, and the conjunctiva having been dried, a glass rod, wetted with nitric acid, should be drawn over the surface of the mucous membrane,

*Treatment.*

Ung. hyd. ox. rub.

Nitric acid.

parallel to and about the eighth of an inch distant from the margin of the lid. Immediately after this application, a stream of water must be syringed over the part, so as to wash away the excess of nitric acid remaining on the conjunctiva; and sweet oil having been smeared over the surface, the lid is to be kept closed with a pad and bandage. It will generally be necessary to repeat this application once a week for a month, before the desired result will be attained. The conjunctiva seldom sloughs, as we might suppose it would do, after the application of the acid, but a sufficient amount of contraction gradually takes place in the hypertrophied tissues to overcome the ectropium, and restore the lid to its normal position; it may be necessary subsequently to slit open the canaliculus.

How to apply it.

Slitting the canaliculus.

In old standing cases, caustics often fail, and it then becomes necessary to excise an elliptical portion of the everted conjunctiva, extending along the breadth of the lid, and parallel to its ciliary margin. The amount of conjunctiva to be removed will depend upon the extent of the displacement; in fact, we must excise a fold of the mucous membrane in ectropium, in precisely the same manner as we remove a portion of skin in certain cases of entropium; all that is required is, when the wound heals and contracts, that the everted lid shall be drawn back into apposition with the eyeball. After the operation, the eye must be closed with a pad and bandage.

Excising a portion of conjunctiva.

I have already observed that, in old standing cases of ectropium, the tarsal cartilage is apt to become elongated from side to side. In this condition of the parts, it would be useless simply to excise a portion of the conjunctiva; to correct this malposition one of the following operations may be resorted to :—

Excise with a bistoury, or strong scissors, an elliptical piece of the conjunctiva, proportionate to the degree of hypertrophy of the mucous membrane, parallel to the inferior (become superior) margin of the tarsal cartilage, and one line distant from it. Then pass three ligatures through the lips of the resulting wound, using a curved needle with a large eye; both ends of each thread are passed together through the eye of the needle, which is guided along the nail of the left index finger, between the eyeball and the eyelid, made to penetrate the

Another operation.

Fixing the lid by ligatures.

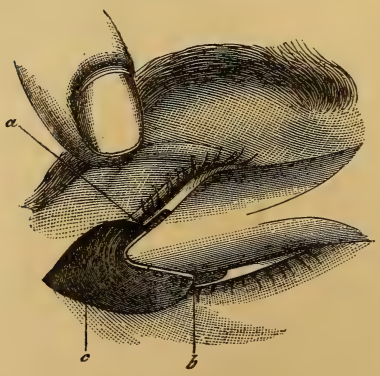
conjunctiva at its angle of reflection from the globe, and brought out as high up as possible through the skin. The two ends of each ligature are then crossed over a bit of plaster, and tied close under the arch of the orbit, as shown in the annexed figure (17). Cold compresses must subsequently be employed to keep down the inflammation, and the ligatures removed at the end of three days.*

Fig. 17.

If the ectropion be accompanied by no great shortening of the integument, and if the margin of the lid is in other respects normal, the excision of a triangular flap, from the outer portion of the lid, and closing the wound by sutures, is generally sufficient. For this purpose the edges of the lids in the outer commissure are slit up with a scalpel. Then a triangular flap of integument is dissected away, and the edges of the wound are united by suture, and a protective bandage applied until adhesion has occurred. In order to lessen the stretching, it is well, before closing the wound, to separate the inner edge of the skin from the tissue beneath for a little distance, particularly if the subcutaneous tissue is somewhat thickened from previous irritation. It is also advisable to diminish the tension of the parts by keeping them drawn together by strips of plaster.

Excision of flap from outer angle of eye.

Fig. 18.




* *Ophthalmic Review*, vol. iii. p. 113.

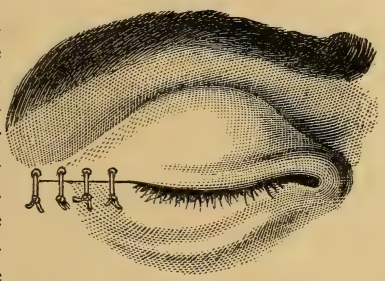
If we wish to secure great elevation of the lid and of the commissure the following proceeding may be adopted :—

Steps of the operation.

While one assistant holds the head of the patient, and another restrains the bleeding, the operator (*see* Fig. 18) pushes a small horn-spatula under the outer commissure, lifts it up from the globe, and splits it into two layers, first thrusting in a broad, lance-shaped knife immediately in front of the fascia tarso-orbitalis, and then enlarging the wound with a scalpel on both lids, up to the vertical boundary lines *a* and *b*.

When this intra-marginal splitting is done sufficiently, the lower and then the upper margin of the lid are pared in a direction inward from the vertical boundary line, for about one-half to three-quarters of a line, by a horizontal incision. The whole breadth of this incision falls behind the ashes (*see* Fig. 18).

FIG. 19.



The horizontal incision is to be made at a greater or less distance from the edge of the lid, according as the outer commissure is to be more or less elevated ; but it should always be so made that the two run together at an acute angle. The integument is dissected up, and the wound closed by three or four sutures. The first suture is placed close to the vertical boundary line (Fig. 19).

Subsequent treatment.

In order to lessen the tension, strips of adhesive plaster as well as the protective bandage, may be used. These are fastened on the cheeks and forehead, drawing up the integument lying between them.

3. Ectropium from cicatrices.

3. Ectropium, arising from the contraction of a cicatrix of the skin, is often a most troublesome deformity to overcome. It matters not if the cicatrix has been formed by a wound or a burn, if it involves the skin of the lid it is almost sure to be followed by ectropium and its consequences. The treatment to

Set free the lid.

be pursued in these cases consists in freeing the lid from the contracting bands of the cicatrix.

Operation in slight cases.

In slight cases it may only be necessary to make an incision through the integument, parallel to the ciliary margin of the lid, and of such an extent as will enable us, by dissecting the subcutaneous tissue from the cartilage, to separate it from the adhering cicatrix. The lid, being freed in this way from the cicatricial tissue, may be closed, and should be kept in this constrained position by passing a suture through its edge, and tying it down to a fold of the skin of the cheek, or forehead, according as the upper or lower lid has been operated on; or in some cases, a well applied pad and bandage will answer the same purpose.

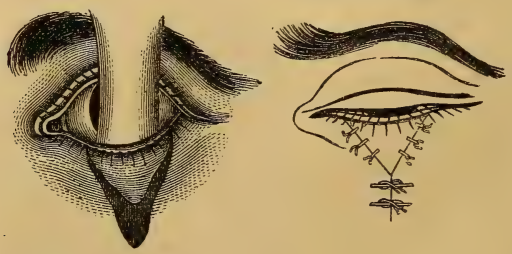
In severer cases.

In more severe cases, the operation recommended by Mr. Wharton Jones should be resorted to. Supposing the upper lid to be everted and bound down to the supra-orbital ridge, Mr.

Jones's operation.

Jones directs* that two converging incisions should be made through the skin, from over the angles of the eye upwards to a point where they meet (*see* Fig. 20), somewhat more than an

FIG. 20.



inch from the adherent ciliary margin of the eyelid. By pressing down the triangular flap thus made, and cutting all opposing bridles of cellular tissue, but without separating the flap from the subjacent parts, we shall be able to bring down the eyelid nearly into its natural situation, by the mere stretching of

* "Ophthalmic Medicine and Surgery," by T. Wharton Jones, 3rd edit. p. 629.

the subjacent cellular tissue. A piece of the everted conjunctiva should be snipped off. The edges of the gap left by drawing down the flap are now to be brought together by sutures, and the eyelid retained in its proper place by plasters, and a compress and bandage. Fig. 20 represents this operation for the lower lid.

Dieffenbach's plastic operation.

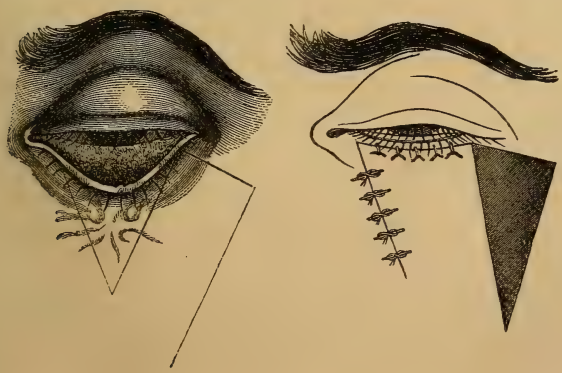
Other surgeons recommend that the cicatrix should be separated from the lid, and a piece of healthy integument, from the cheek or forehead, transplanted into its place. Of the operation proposed, that known as Dieffenbach's is generally to be preferred, though it is almost impossible to lay down any rules strictly applicable to all instances; each case requiring some special modification, which the skill and ingenuity of the surgeon must supply at the time of the operation.

Dissection of cicatrix.

Dieffenbach's operation is performed as follows:—The cicatrix is first to be dissected away, so as to leave a triangular wound having its base towards the margin of the lid, the line of the ciliary border of the lid and tarsal cartilage being, if possible, preserved. But if these have been destroyed, the conjunctiva alone remaining, it is to be dissected out and laid over the eyeball. The surgeon then makes an incision (*see* Fig. 21), through

Transplanting the skin.

FIG. 21.



the sound skin and subcutaneous tissues, extending from one or other of the angles of the base of the triangular wound already

made, according to the situation of the cicatrix. From the outer extremity of this incision, a second one is to be carried parallel to the edge of the triangular wound; the enclosed flap is then to be dissected from off the subcutaneous tissue, and being transposed, is to be fitted into the gap left by the cicatrix; the margin of the transplanted skin is then to be carefully united to the edges of this wound by fine sutures. Water-dressing should be subsequently applied, and the part kept at rest. The flap may be formed, half from one side of the cicatrix, and half from the other side, but under any circumstances it must be considerably larger than the gap it is intended to fill; in fact, one is hardly likely to err in making too large a flap, but mistakes are often made in transplanting too small a portion of skin.

Sutures and dressing.

Precaution.

I can do no more than indicate the principles upon which these operations depend; their details must vary with the particular circumstances of individual cases, and in most of these cases more can be effected by careful skin-grafting than by plastic operations.

TRICHIASIS, OR INVERSION OF THE CILIA, sometimes follows neglected cases of conjunctivitis, or tinea tarsi. Occasionally only a few isolated eyelashes are incurved, the remainder retaining their normal position; at other times the whole of the cilia, or all of those growing from one part of the eyelid, are affected; but under any circumstances the result is the same, the irritation caused by the cilia rubbing against the surface of the eyeball induces conjunctivitis and keratitis, and, in time, opacity of the cornea and loss of sight. Entropium differs from trichiasis, therefore, in that the ciliary margin of the lid in the former affection is curved inwards, and with it the cilia, whereas in trichiasis the lid may be healthy, but the cilia are inverted against the surface of the eyeball.

Trichiasis.

Eyelashes grow inwards.

A source of irritation.

*The Symptoms* to which trichiasis gives rise will depend upon the extent of the disease, and the situation of the inverted hairs; a few of the eyelashes rubbing against the eyeball, at the outer angle of the eye, will not cause so much inconvenience to the patient as a single hair, if inverted against the

cornea. Cases of trichiasis, if left to themselves, will, in the first instance, give rise to persistent conjunctivitis, followed by haziness, and ultimately vascular opacity of the cornea. Conjunctivitis. Opacity of the cornea.

If only a few of the cilia are incurved, they are apt to be overlooked, chronic conjunctivitis being the prominent symptom which first attracts our attention. Immediately, however, that the lid is everted, so as to expose its ciliary margin, the ingrowing eyelashes will be detected; it is advisable for this reason, in all cases of persistent conjunctivitis, to examine the margin of the lids, and notice the condition of the cilia. The cause overlooked.

In ordinary muco-purulent conjunctivitis the eye is irritable, and the patient, by constantly rubbing it, sometimes causes one or more of the eyelashes to become inverted, and this contributes to keep up this inflammation. In a case of this kind, astringent lotions will be useless unless the offending cilia be removed. Varieties of trichiasis.

It occasionally happens that people are born with a double row of eyelashes; the inner ones, under these circumstances, are often inverted; and must be treated upon the principles above indicated. A double row of cilia.

*The Treatment* to be adopted in cases of trichiasis depends very much upon the extent of the disease; if only a few of the cilia are incurved, the offending hairs should be seized one by one with a pair of forceps, and pulled out from their follicles. It is necessary to be careful not to break off the cilia, or the stiff ends left in the eyelid will, by rubbing against the cornea, do more harm than the entire hair would have done. Each cilium must therefore be seized close to the margin of the lid, and slowly and cautiously pulled out, root and all. Unfortunately we cannot extract the hair bulbs in this way, and the consequence is, that another eyelash speedily springs up in place of the one we have removed, and usually takes the direction of its predecessor,—so that if extraction be alone resorted to, it is constantly necessary to watch for the production of new eyelashes in the track of the old ones. *Treatment.* Extraction of cilia. Care required.

The most effective way of dealing with inverted eyelashes when they are few in number, and of considerable size, is to

adopt the method advocated by Celsus, and described as follows by Dr. Argyll Robertson :—

The principle of the operation consists essentially in causing the offending eyelashes to be mechanically turned away from the eye, and made to grow more or less in the proper direction by making them pass under a narrow bridge of skin. The following is the method of performing the operation :—A fine curved needle has the two extremities of a waxed silk ligature (or hair, as Celsus directs) passed through its eye. The needle, being firmly grasped by suitable forceps, is then passed through a narrow fold of skin at the very margin of the lid, close to one of the inverted eyelashes. The point of introduction should be external to the point of emergence of the eyelash, but as close to it as possible : and the needle should be brought out after passing about $\frac{3}{4}'''$ or $1'''$ under the skin (Fig. 22). The needle and ligature should be drawn through until a small loop alone remains, when, by means of a fine pair of forceps, the eyelash is passed through the loop (Fig. 23). Traction is then made on the ligature, and the loop with the entangled eyelash is drawn through the tunnel in the skin (Fig. 24). The other misdirected eyelashes are similarly treated.

FIG. 22.

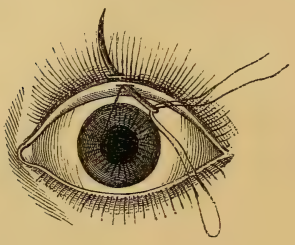


FIG. 23.

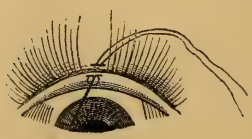
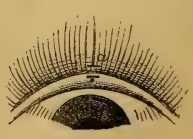


FIG. 24.



Very little irritation follows this operation, and no special after-treatment is necessary. The patient, however, must be warned against touching or rubbing the eyelashes for twenty-four hours

after the operation, as he might thus force the eyelashes back out of their new channel.

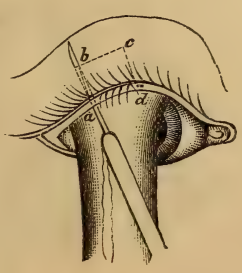
Three or four cilia may be treated in this way with success; but in old-standing cases, in which, perhaps, the whole of the eyelashes are incurved, or those of the outer or inner half of the lid are affected, it will be necessary to resort to other means. The whole of the cilia may have to be removed, together with their bulbs, as described in cases of Entropium, page 101, or a portion or the whole of the tarsal cartilage may have to be grooved above the position of the inverted cilia, in order that they may be restored to their normal position. This operation I have found to be particularly useful when the outer half of the cilia are diseased. Occasionally the excision of a portion of the skin of the lid will evert the palpebral margin sufficiently to prevent the incurved eyelashes from rubbing against the eye; but there can be no doubt, in severe cases, that any proceeding which actually destroys the eyelash and its bulb is to be preferred to an operation which merely everts the palpebral margin of the lid,—trichiasis, as before remarked, not being a disease simply of the eyelid but of the eyelashes.

Excision of the bulbs.

Grooving the cartilage.

Of the operative proceedings intended to accomplish this object, the following is the best* (Fig. 25) :—A needle is to be threaded with fine silk, and entered between the inner and outer margins of the border of the lid, *a*, and made to pierce the skin a little above the ciliary margin, *b*. The thread is drawn through, and the needle caused to re-enter at the last orifice, *b*, and made to run parallel with the border of the lid, for the space in which the cilia maintain the wrong direction (to *c*). The thread is again to be pulled through, and the needle again entered at the last point of

FIG. 25.




Destroying cilia by ligature. Operation.

* "Illustrations of some of the Principal Diseases of the Eye," by H. Power, M.B., p. 157. Lond. 1867.

emergence, and directed vertically till the point reappears between the edges of the border of the lid, *d*. The two ends are then to be tied, and the thread allowed to cut its way out. The suppuration excited thoroughly destroys the bulbs of the offending cilia, and no further trouble is experienced.

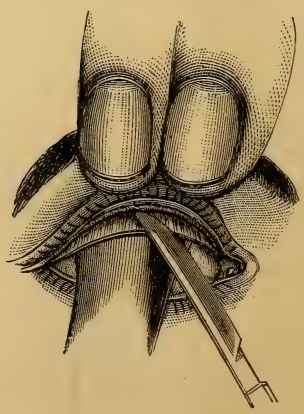
Transplanting the ciliary margin.

In the more inveterate cases of trichiasis, a kind of transplantation of the outer lip of the lid, and the hair follicles beneath, is of great value.

Operation.

It is better to perform this operation while the patient is under the influence of an anæsthetic, on account of the great pain it causes, and because of its tediousness. An assistant, who at the same time holds the head, places a horn-spatula under the lid, raises it up from the globe, and causes the edge of the lid to be somewhat everted from the spatula. Then the edge of the lid is divided into layers, for the depth of two lines, with a delicate scalpel (*see* Fig. 26), the incision not being continued inwards as far as the lachrymal punctum. The posterior layer contains the conjunctiva, with the cartilage and canals of the tarsal glands, and the anterior includes the remaining structures, with all the hair follicles.

FIG. 26.



The incision should, therefore, be made close to the surface of the cartilage. Then a second incision is made, one and a half to two lines above, and parallel to the outer lip, completely through the anterior layer, down to the cartilage, and in such a manner that the two ends of the wound extend beyond the ends of the first incision. This layer is thus changed into a kind of bridge, to whose posterior surface the hair follicles are attached, and which is only connected to the lids by the two extremities. When this bridge has been formed, a

crescentic incision is made, beginning at the ends of the last incision, through the integument. This is seized with the forceps, and carefully dissected up, without injury to the orbicularis muscle. The size of this flap should be the larger, and have a greater vertical diameter, in proportion as the hairs are turned inward, and the more the skin is relaxed and wrinkled. The edge of the crescentic incision, and the bridge of skin containing the cilia, are now to be brought together by means of sutures; under the traction of these sutures the direction of the hairs becomes horizontal or is even turned toward the orbital border. The sutures should be removed on the third day.* I have found this operation most useful in many bad cases of trichiasis.

Union of Eyelids.

ADHESIONS OF THE EYELIDS.—The ciliary margins of the eyelids sometimes become united either wholly or in in part; this may arise from a congenital defect, or from any cause which gives rise to abrasion of the skin along the free margin of the lids, their raw surfaces growing together, and rendering the eye useless for all practical purposes. This is, however, a rare consequence of disease: it far more commonly follows chemical or mechanical injuries of the parts.

*Treatment.*

*Treatment.*—When the margins of the lids grow together, whether from congenital defect or from injury, a director should be passed behind the adhesions, and they should be slit through with a knife or pair of scissors. It will be necessary to keep the lids separated from one another until the edges of the wound have cicatrized. Unfortunately, the majority of these cases are complicated with adhesions between the palpebral and orbital portions of the conjunctiva, which it is most difficult to cure. Adhesions of this kind are called *symblepharon*, and are described under the head of diseases of the conjunctiva.

Complications.

Œdema.

ŒDEMA OF THE LIDS is incidental to the progress of various diseases—as, for instance, abscesses, and inflammatory affections of the skin of the face; or more remote ones—such as

Incidental to various diseases.

* Drs. Hackley and Roosa's translation of Stellwag von Carion on "The Eye," p. 386.

diseases of the kidneys or heart. But among the poorer class, we often meet with cases of œdema under the following circumstances :—The patient probably states that he had been perfectly well prior to going to sleep, and lay down to rest in some exposed spot. In the morning, he was unable to open his eye, on account of the lids being stiff and swollen ; there may have been some pain in the part, but this is not always the case. The eyelids are œdematous, shining, and swollen, but not discoloured ; and on forcing them open, the orbital conjunctiva will also be found œdematous, but not inflamed. This state of things usually arises from one of two causes : either from the sting of an insect, or from the effect of the damp night air blowing over the patient's face. As a general rule, if occurring from the poison of an insect, the point of the sting or bite will be marked by a spot, which is more painful and inflamed than the rest of the swelling ; moreover, both eyes are rarely affected in this way. Whereas, when the œdema arises from cold, there is seldom any pain in the part, except that caused by the tension and swelling of the cellular tissue of the lid, and both eyes are generally equally affected ; nor are the eyelids red and inflamed.

From stings of insects.

From cold.

In these cases no special treatment is required ; the part may be bathed with a solution of acetate of lead. The œdema generally disappears of itself very rapidly.

HORDEOLUM, or, as it is commonly called, *a stye*, consists of a swelling of a tarsal gland, which inflames, and not unfrequently suppurates. The little abscess is seated, therefore, in the thickness of the lid, and the integument may be made to glide over it. The swelling varies in size from that of a millet seed to that of a bean ; and is hard to the touch. Abscesses of this description generally occur among debilitated people, and they are more common among children than adults.

HORDEOLUM, or "STYE."

Styes commence with an itching sensation in the part, which soon becomes red and swollen, the lid often being œdematous and very painful.

*Treatment.* In the early stages of the disease the eyelash passing through the inflamed spot should be extracted, and a fine point of the diluted nitrate of silver should be immediately applied to the mouth of the open follicle ; the inflammatory action may be

Arg. nit.

arrested by these means. But if suppuration has occurred, it is better to apply warm poultices to the eye, changing them every second hour; and as soon as the abscess points, it should be incised. Tonics are frequently called for, and, unless prescribed, successive styes are apt to appear one after the other, to the great annoyance and discomfort of the patient.

Poultices.

Tonics.

BLEPHARITIS, OR TINEA TARSI, consists of an eczematous inflammation affecting the margin of the eyelids, and is most frequently met with among the children of the poor, living in the crowded parts of our large towns. Under any circumstances it too frequently runs a subacute course, unless the greatest attention is paid to the case in the first instance.

BLEPHARITIS.

Dyscrasial.

Tinea tarsi may be conveniently divided into two stages; in the first, active changes are still going on at the margin of the eyelids; and in the second, the cilia have been destroyed, and the margins of the lids are thickened and indurated, presenting the condition known as *lippitudo* or *blear-eye*.

Two stages.

*Symptoms.*—The patient complains of what he usually terms weak eyes; they itch a good deal, particularly after work, and on rising in the morning they are often glued together. Symptoms of this kind may have been going on for a long time, inconveniencing the patient a good deal, but not being sufficiently severe to prevent his performing his usual work. Young children are hardly likely to complain of their eyes in the early stages of the disease, as there is no actual pain in the part.

1st stage, "weak eyes."

On examining the eyelids of a person suffering from tinea in its early stages, we notice a crust, or scab attached to a part or the whole of the free margin of the patient's eyelids; beneath these crusts are a number of little pustules at the roots of the cilia: the skin is slightly red and inflamed. A succession of these pimples form and burst, leaving a scab clinging to the skin with considerable tenacity. The conjunctiva is always somewhat injected.

Ciliary pimples.

Scabs.

This state of things having lasted for a longer or shorter period, the sebaceous and Meibomian glands become irritable, and their secretion is augmented in quantity and altered in quality, so that the lids stick together during sleep. The skin

Lids stick together.

Margins ulcerate.

beneath the scabs at length becomes ulcerated and swollen; the crusts are no longer furfuraceous, but hard and thick, and the eye is very irritable; the patient cannot read or work for even a short time, without his eyes becoming red and painful. In consequence of the swollen condition of the margins of the lids, the puncta are thrust away from the eyeball, and the tears accumulating in the lacus lachrymalis, not only flow over the side of the cheek, but by remaining in contact with the eye induce chronic conjunctivitis; this, in its turn, by presenting a rough surface to the cornea, induces changes in its epithelial layers, not amounting to any perceptible opacity, but sufficient to interfere slightly with the perfection of vision.

Conjunctivitis.

2nd stage.

If the disease should advance to its second stage, destruction of the eyelashes and hypertrophy of the free margins of the lids take place, in consequence of the long-continued irritation that has been going on there. It by no means follows, however, that the cilia are completely destroyed; but they frequently drop out, the bulbs of the hairs remaining, and from them distorted misdirected cilia spring, some of which, turning inwards, produce trichiasis. The surface of the skin beneath the scabs being ulcerated, and discharging a quantity of matter, thick crusts form on the edges of the red and hypertrophied eyelids: at the same time the Meibomian glands become inflamed, and in too many cases the ducts leading from them ultimately close, the disease is then incurable. The margins of the lids are thickened, and the puncta being thus everted, and often closed, the tears stream over the inner corner of the eye: the cornea becomes hazy, and the patient's state is miserable in the extreme.

Cilia distorted or shed.

Trichiasis.

"Bleared eyes."

*Treatment.*

*Treatment.*—The treatment of tinea tarsi is complicated by two unfavourable circumstances: the first is, that it most often occurs among children, who are impatient of treatment; and secondly, they generally live in neglected, dirty habitations, being the offspring of unhealthy parents.

In conjunction with constitutional treatment, comprising the preparations of arsenic and iron combined, as a rule, with cod-liver oil, local remedies are most useful. In the first instance, the scabs on the margins of the lids must be removed by a poultice, or the application of hot fomentations; after the scabs have

Remove the scabs.

been softened they may be detached with a rag and hot water. Having removed the scabs, an ointment composed of half a drachm of hyd. oxid. flav. to an ounce of vaseline should be carefully applied along the margins of the eyelids, or the ung. hyd. nitrico-oxidi dil. one drachm, cacao butter three drachms, may be employed in the same way. The chief point, however, to attend to is, that the ointment be brought in contact with the diseased surface : if simply smeared over the scabs, the medications will be useless.

Apply mercurial ointment.

In more confirmed cases, where the margins of the lids have ulcerated, the lashes should, in the first instance, be cut off close to their roots, and the scabs removed with a pair of forceps ; after which, a pencil of mitigated nitrate of silver should be drawn along the outer edge of the ulcerated surface, or we may paint the part over with the tincture of iodine ; or a strong solution of nitrate of silver. The surgeon must of course make these applications himself, and subsequently the dilute oxide of mercury ointment may be used by the patient ; but the lids will probably have to be painted over with the tincture of iodine twice a week for some time. Great care will be required to keep the parts clean, bathing them several times a day in a solution of carbolic acid, one part in 100, to which two grains to the ounce of sulphate of alum should be added.

In confirmed cases cut off cilia.

Apply arg. nit. or tinct. iodinii.

Dr. Tilbury Fox recommends carbolic acid dissolved in glycerine to be used in place of the tincture of iodine. I have found this acid most useful in cases of tinea tarsi, employed as above directed, of the strength of one part to five ; and subsequently, one grain of carbolic acid, ten of acetate of lead, and two drachms of vaseline, to be smeared along the margin of the lid with a camel's hair brush night and morning.

Carbolic acid.

In most forms of chronic tinea (lippitudo) little can be done to alleviate the disease ; the mischief it has effected being, in fact, irreparable. We may, however, remove the bulbs of the cilia, and thus cure the trichiasis, and to some extent the consequent opacity of the cornea. The carbolic-acid lotion will be useful to relieve the ulcerative process ; but the thickened, hairless state of the margins of the lids will continue in spite of our best efforts.

Lippitudo incurable.

Pediculi. PEDICULI.—Lice occasionally take up their abode among the cilia, their ova covering the eyelashes, and the cilia looking as if they had been dusted over with a black powder. These parasites give rise to the most intolerable itching of the part, the patient almost tearing the cilia out by their roots; beyond the irritation, the eye appears to be healthy. On looking carefully at the eyelashes they seem to be covered with powder or dust, and with a lens the lice may be distinctly seen. The treatment to be adopted is to wash the parts well with warm water, and then smear the palpebral margin and cilia with staphisagria, and if this fails, with the blue mercurial ointment.

Mercurial applications.

## CHAPTER V.

### DISEASES OF THE LACHRYMAL PASSAGES.

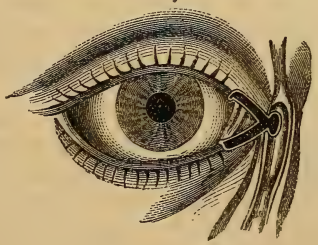
*Displacement and Obstructions of the Puncta and Canaliculi—Inflammation of the Sac—Obstruction of the Nasal Duct—Defective Secretion of Lachrymal Gland—Epiphora—Lachrymal Cysts and Fistulæ.*

Obstructions in the Puncta.

DISPLACEMENT AND OBSTRUCTION OF THE PUNCTA.—In the healthy eye, the lachrymal puncta are in contact with the eyeball, and cannot therefore be seen unless the eyelids are everted. When the eye is closed, the puncta are situated in the lacus lachrymalis, so that the secretion from the surface of the conjunctiva, whether the person is sleeping or waking, can always drain away through the puncta into the canaliculi, lachrymal sac, nasal duct, and so down into the nose (Fig. 27).

Position of in health.

FIG. 27.



Any cause which displaces the puncta, or which obstructs the passage of the tears into the nares, gives rise to an accumulation of the lachrymal secretion in the lacus lachrymalis, which in time overflows, and running down the cheek, causes the patient considerable inconvenience.

Effects of obstruction; lachrymation,

*Epiphora*, or a watery eye, is thus induced, and a tear is left constantly in front of the cornea, which, by interfering with the rays of light in their passage to the eye, renders it necessary for

the patient to be perpetually wiping his eye before he can see clearly; and lastly, the prolonged contact of the tears with the surface of the eye gives rise to chronic conjunctivitis and its consequences.

conjunctivitis.

Obstruction of the lachrymal puncta may be either partial or complete—that is, one or both the puncta may be closed, giving rise to symptoms such as I have above described.

Diagnosis by pressure over the sac,

If in the healthy eye, pressure is made over the lachrymal sac, a drop of fluid may be seen to ooze out through the lachrymal puncta. Should one or both puncta be occluded, fluid cannot be made to regurgitate through the obstructed orifice. Under these circumstances also we shall find it difficult to pass a probe into the canaliculus.

and use of a probe.

*Treatment.*

*Treatment.*—In cases of congenital deficiency of the puncta, or when it has been completely closed from the effects of a burn or other causes, it may generally be detected as a small depression near the inner extremity of the palpebral margin. It by no means follows that because the puncta are closed, the canaliculi are also occluded; so that, in some instances of this kind, all that is necessary is to evert the lid; a sharp-pointed probe or other instrument is then to be run through the obstruction in the direction of the canaliculus, the punctum being laid open. If a full-sized lachrymal probe can be passed through the canaliculus into the lachrymal sac, there will be no necessity for any further treatment, beyond the insertion of the instrument through the incision every day, for four or five days, to prevent its edges from uniting.

In complete closure,

pierce the membrane.

Pass a probe daily.

Partial obstructions,

It by no means follows, however, that the puncta are always completely occluded; but they may be so contracted that it is difficult for the lachrymal secretion to find its way through them in sufficient quantities to keep the corner of the eye free from an accumulation of fluid. Under these circumstances, a narrow beak-shaped knife, made for the purpose, may be passed through the punctum, and its inner and upper wall incised, and subsequently kept dilated as above described.

similarly treated.

STRICTURE OF THE CANAL.

OBSTRUCTION OF THE CANALICULUS may be permanent or spasmodic. A permanent stricture, whether partial or complete, will give rise to the same symptoms as occlusion of the puncta,

Permanent.

and for the most part it arises from a similar cause—namely, chronic inflammation of the mucous membrane. A foreign body, as, for instance, a cilium or calcareous concretion, occasionally closes the canal. Causes.

Spasmodic stricture of the canaliculus occurs either at the inner or outer opening of the canal, and the watery eye accompanying it may be of an intermittent character, depending on relaxation at one time and spasm at another of the constrictor muscle. There is never the same resistance to the passage of an instrument in cases of this kind through the canaliculus as in instances of permanent stricture. Spasmodic stricture.

*Treatment.*—Unless the obstruction is of some standing, attempts should hardly be made to pass an instrument, as the stricture may arise simply from congestion of the lining membrane of the canal, and astringents will cure it; whereas the injudicious use of a probe, by wounding the mucous membrane, may cause a permanent obstruction. On the other hand, if the patient has complained of symptoms of occlusion of the lachrymal passage for some two or three months, it is better, under any circumstances, to operate at once. Old standing cases of obstruction, from whatever cause they arise, seldom improve under local applications, and the sooner the puncta is enlarged the better. *Treatment.* If recent, delay interference. In old cases operate at once.

An assistant, or the surgeon, with the thumb of one hand should evert and draw the lids outwards; a beak or probe-pointed knife must be run through the puncta and a short distance along the canaliculus, so as to lay the punctum freely open. The edges of the incision should subsequently be prevented from uniting by passing a probe through the wound every day for a week, after which the channel will remain permanently open, and the lachrymal secretion pass through it into the sac. The line of the incision should be directed inwards, or towards the eye, so that it will be in apposition with the eyeball, otherwise the tears will not be able to find their way into the canal from the surface of the lacus lachrymalis. It is seldom necessary to do more than divide the punctum and the commencement of the canal leading from it. 1. If incomplete, open the canal on a director. Pass a probe daily.

Supposing, however, we should meet with a case in which

2. In complete stricture.

stricture of the canaliculus is both complete and permanent, so that we cannot pass even the finest director along the canaliculus into the sac, it is evident that we must endeavour to effect another passage for the tears, either through the upper canaliculus or from the lacus lachrymalis into the sac, behind the tendo-palpebrarum. The sac having been punctured from this latter direction, the opening must be maintained by passing a probe through it every day, so as to form a fistula between the inner angle of the eye and the lachrymal sac.

Form a fistula to the sac.

PHLEGMON OF THE SAC.

PHLEGMON OF THE LACHRYMAL SAC is attended with great pain, and often gives rise to fever and considerable constitutional disturbance. Phlegmon of the sac commences as a small, hard, and painful tumour, situated at the inner angle of the eye; as the inflammation advances, the skin covering the sac becomes tense and shining, the swelling extending to the cheek and eyelids, which often become so œdematous that it is impossible to open them. Such a case may resemble one of purulent conjunctivitis; the absence, however, of a purulent discharge from the eye, and the excessively painful spot at its inner angle, sufficiently indicate the nature of the disease.

Pain and swelling.

Abscess.

If the inflammatory action runs on unchecked, suppuration takes place, and fluctuation may be felt over the region of the sac; the matter points outwards, and ultimately discharges itself through an opening in the skin. The inflammation then subsides, and the parts may return to their normal condition. But it too often happens, if the disease is allowed to take its course, that it terminates in fistula lachrymalis. This perhaps closes, and an abscess again forms, so that gradually the mucous membrane lining the sac and nasal duct is destroyed, and the passage of tears into the nose is permanently closed.

Fistula.

Nasal passage closed.

Occasionally caries or necrosis of the lachrymal bone follows as a consequence of an abscess of the lachrymal sac. More frequently, however, complications of the kind are only met with among scrofulous and syphilitic patients.

*Treatment.* *Treatment.*—In the early stages of this disease, it is advisable to paint the skin over the inflamed sac with a strong solution of nitrate of silver, and ice or cold compresses may be con-

Arg. nit.

stantly applied to the part. If suppuration has commenced, we should at once run a probe-pointed knife through the punctum and canaliculus into the sac.

If the abscess cannot be opened in this way, the lids should be separated as far as their swollen state will permit; and a knife should be thrust into the tear sac, the point of the instrument being entered in the depression existing between the commissure of the lids and the caruncle. In some few instances the swelling of the parts is so great that it is almost impossible to open the abscess by either of the methods above described, and under these circumstances it is necessary to make an incision through the skin directly into the most prominent point of the abscess. In spite, however, of all our care, a fistula may form between the sac and the surface of the skin, through which there is a constant discharge of tears: the skin around the opening becomes thickened and excoriated, and from contraction of the integument ectropium may supervene, adding very much to the patient's discomfort.

Open abscess internally,

or through the skin.

FISTULA LACHRYMALIS.—Fistula of the lachrymal sac generally arises from inflammation of the sac and subsequent stricture of the duct. It may occur from injury or other causes, by which a communication is established between the skin and the sac; it is often kept open by obstruction of the nasal duct, the lachrymal secretion passing through the puncta and out through the fistula, instead of into the nose.

FISTULA LACHRYMALIS.

Causes.

*Treatment.*—The first and most obvious aim in the treatment is to open the normal passage for the tears into the nose, by dilating the nasal duct. This was formerly done by passing *a style** through the fistula into the duct, and retaining it there; the passage after a time becomes dilated, and the fistula heals. But the difficulty in this method is to retain the style in the duct; and although various ingenious contrivances have been invented for the purpose, they do not appear to answer, and the style has

*Treatment.*

The "styl."

Now little used.

* A style is a small piece of silver wire, about one-twentieth of an inch thick, and one and a half inches long, having a neck bent at an obtuse angle with the shaft of the instrument, and terminating in a head.

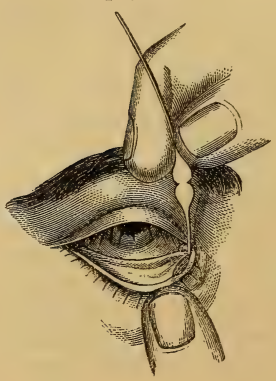
now been almost abandoned. In place of it, the lachrymal sac is opened, as I have before described, by slitting up the punctum and canaliculus and gently passing the blade of the knife through the sac along the nasal duct down into the nares.

Slit the canal and pass a probe into the nares.

If the surgeon is thoroughly acquainted with the anatomical relations of these parts, he will have but little difficulty in passing a lachrymal probe through the sac into the nasal duct. The lid should be everted, and by stretching the canal, as before indicated in the operation for stricture, we avoid the risk of forcing a fold of the mucous membrane before the point of the probe, which would prevent the instrument from entering the nasal sac. The probe is then passed horizontally along the opened canaliculus until its extremity reaches the inner bony wall of the sac. The direction of the instrument is then turned vertically, as shown in Fig. 28, and gently passed down through the sac, its point being then directed a little outwards and forwards, it passes into the nasal duct and so reaches the nose.

Indications of stricture.

FIG. 28.



Pierce obstructions.

If the probe is arrested at the point where the canals coalesce, and join the sac, the fact may be known by noticing that the skin near the tendo-oculi is moved when the probe is moved and an elastic resistance is experienced; whereas, if the probe has entered the sac, it reaches the inner bony wall, and the skin is motionless.* If we find an obstruction of this kind preventing the probe from entering the duct, the instrument must be withdrawn, or its point turned in different directions until the probe enters the duct; but this is hardly likely to be the case if the blade of the knife has previously passed along the canal.

* Mr. Bowman on Lachrymal Obstruction: *Ophthalmic Hospital Reports*, vol. i. p. 16.

The size of the probe to be employed will vary with the nature and extent of the obstruction it has to overcome. As soon as the end of the probe touches the mucous membrane of the nose, the patient feels it there, so that there can be no mistake as to the passage of the instrument. I need hardly remark that it is necessary to handle the instrument lightly when endeavouring to pass it through a stricture in the nasal canal, otherwise we are likely to lacerate the mucous membrane, or, it may be, run the probe through the bony wall of the canal. Using great caution.

In the case of stricture of the sac or nasal duct, complicated with a lachrymal fistula, the probe should, if possible, be passed for a time through the duct about twice a week. The natural passage of the tears being thus restored, the fistula will probably heal of itself.

It often happens, however, that our efforts to restore the natural channel for the tears are ineffectual, and consequently the fistula remains open, to the great annoyance of the patient. To remedy this state of things, three methods of procedure are open to the surgeon—1st, the introduction of a style; 2nd, the obliteration of the lachrymal sac; and 3rd, removal of the lachrymal gland.

1. I have already spoken of *the style;* if the surgeon determines to employ it, the following is the method of doing so.* Should the fistula not be in such a position as to enable us to pass a probe through it into the nasal duct, it must be slit up so as to allow of this being done. We may then pass an ordinary lachrymal probe through the duct into the nares. The style may subsequently be introduced, and allowed to remain in the duct for two or three days, when it must be withdrawn, cleansed, and returned into the duct. In the course of time the canal becomes enlarged, and in the interim the tears find their way down into the nose along the sides of the style. 1. The style. How used.

The cure, however, is a tedious one; and after all, when the style is permanently removed, the duct is very apt to contract again. But independently of the chances of a relapse, the irritation caused by the style is often so great, that people Objections to styles.

* "Maladies des Yeux," par L. A. Desmarres, tom. i. p. 369.

cannot possibly wear it; and lastly, it is apt to slip from its position, and the patient cannot return it into the nasal duct. Consequently, the method of treating a fistula by means of a style is not a promising one.

2. Obliteration of the sac.

2. Obliteration of the lachrymal sac, in cases of fistula, has been advocated by Dr. Manfridi,* of Turin.

The lachrymal sac must be laid completely open, and, if necessary, the tendon of the orbicularis cut through to expose the superior end of the sac. Manfridi then introduces a speculum into the wound, and the sac is to be carefully cleansed of blood and matter; after which its entire surface is to be smeared over

By chloride of antimony

with chloride of antimony. A piece of dry lint is to be placed in the cavity, over which poultices may be applied, our objects being "the total destruction and extrusion of the sac, without which we cannot hope for a complete and permanent result." After the destruction and enucleation of the sac in this way, "a channel of communication sometimes still exists between the lachrymal conduits and the nasal canal."

Mr. Windsor, of Manchester, prefers, after completely laying open the lachrymal sac, to fill it with dry lint, allowing the lint to remain in the sac for two days. It is then removed, and the walls of the sac having been thoroughly cleansed, the cavity is

or chloride of zinc.

to be filled with lint soaked in the chloride of zinc paste, which should be allowed to remain in the sac for two hours. The lint may then be removed, and water-dressing applied. The sac sloughs, and comes away in the course of a few days, and the wound rapidly heals.

3. Removal of lachrymal gland.

3. Lastly, removal of the lachrymal gland, for the cure of a fistula of the lachrymal sac, has been practised.

CHRONIC INFLAMMATION OF THE SAC.

CHRONIC INFLAMMATION OF THE LACHRYMAL SAC is a common form of disease. It usually commences with subacute inflammation of the lining membrane; but the irritation extending to the mucous membrane of the canaliculus and nasal duct these passages become swollen and obstructed, and the sac is

Mucus collects in the sac.

slightly distended in consequence of the accumulation of mucus

* *Ophthalmic Review*, vol. ii. p. 418.

within it. Under these circumstances, if pressure be made over the sac, a whitish, glairy fluid may generally be forced through the puncta. The lachrymal secretion cannot pass through its natural channel, and accumulating in the inner corner of the eye, it runs down over the cheek, giving the patient constant annoyance; he seldom complains of pain in the part, but is occasionally troubled with an itching sensation in the region of the sac.

Lachrymation.

No pain.

Chronic inflammation of this kind may exist for months, without either increasing or receding; but at any time acute inflammation may supervene, and an abscess of the sac and fistula result.

Abscess may form.

*Treatment.*—It is advisable, as soon as possible, to open the sac by slitting up the lower punctum and canaliculus, and to run the knife down through the nasal duct; subsequently the edges of the wound should be kept apart till they have healed, so as to establish a permanent opening into the sac, and a lachrymal probe will have to be passed, to keep up a free communication into the nares. The patient should make pressure with his finger over the inner corner of the eye three or four times a day, so as to empty the sac. The recovery is expedited by syringing out the sac once a day with an astringent lotion (two grains of alum to an ounce of water), after having pressed out the contents of the sac; the lotion may be injected with an Anel's syringe. It is advisable to continue this application for some time after all symptoms of the inflammatory action have disappeared.

*Treatment.*

Open the sac.

Keep it empty.

Inject astringent lotions.

MUCOCELE consists in an accumulation in the lachrymal sac of its normal secretion, the nasal duct being almost always occluded, and in the majority of cases there is also more or less obstruction in the canaliculi, a watery eye results, and the sac becoming distended, a small tumour forms at the inner angle of the eye, its size varying from that of a split pea to a pigeon's egg. The patient complains of little or no pain in the part, and the skin over the sac is not inflamed. During the early stages of the disease fluctuation may be felt in the sac, but as it becomes more distended and tense, it might be mistaken for a fibrous growth: the canaliculi and nasal duct being occluded to a greater or less extent, it generally requires firm pressure to be

MUCOCELE.

Mucus collects in sac.

Forms a firm tumour.

made over the mucocele before its glairy contents can be forced out through the puncta.

*Treatment.* *Treatment.*—The sac having been opened through the canaliculus, it will then be necessary to dilate the obstruction in the nasal duct as I have already described; for it must be remembered that both the upper and lower openings into the sac are for the most part closed in cases of mucocele. These obstructions having both been overcome, we may hope to restore the passage of the tears into the nose, and thus effectually cure the disease.

Remove the obstructions.

Polypi and Concretions. Polypi and Concretions in the Sac.—A polypus has been known to grow from the lining membrane of the lachrymal sac. Calcareous concretions also may form in it, obstructing the passage of the tears into the nose. A polypus in this situation is a very rare form of disease; it induces symptoms similar to those of mucocele, but the tumour feels less elastic to the touch, and no fluctuation can be felt in it. If there is any doubt on the subject, a grooved needle may be run into the tumour and its character ascertained with certainty.

How distinguished. The nature of the obstruction, if arising from calcareous matter, may be at once ascertained by passing a probe into the sac; the contact of the instrument with the sandy particles, accumulated either there or in the canaliculus, cannot be mistaken for any other condition of the parts.

*Treatment.* In cases of this kind the canaliculus and sac must be laid open, and the calcareous matter turned out of them. The same remark applies to the treatment of a polypus; but in this case the tissues covering the sac must be divided, and the polypus carefully removed, together with its peduncle, otherwise it will certainly grow again.

By careful removal.

Obstruction of Nasal Duct. Obstruction of the Nasal Duct.—The nasal duct sometimes becomes partially, or it may be wholly obliterated, most commonly from chronic inflammation and thickening of the lining membrane; but it may be from periostitis, or disease of the bones forming the walls of the lachrymal duct.

Swelling of the sac. *The symptoms* caused by obstruction of the duct are, dryness of the corresponding nostril, the formation of a slight painless and elastic swelling in the position of the lachrymal sac, and a

constant overflow of tears from the eye. By pressure over the region of the sac, we may determine whether the obstruction is in the nasal duct, or between the puncta and the sac; if the latter, there will be no regurgitation of muco-purulent fluid through the puncta; but if the stricture be in the nasal duct, though the symptoms above enumerated exist, the lachrymal secretion will find its way into the sac, and on pressure being made over it, a drop of fluid will ooze through the puncta. If the stricture is not complete, some of the secretion may find its way down into the nose.

Lachrymation.

Regurgitation by puncta.

*The Treatment* of stricture of the nasal duct has already been described, page 128. Should the obstruction be a bony one, which is very rare indeed, compared with the number of cases that occur from thickening of the mucous membrane, we are not likely to cure it with the probe; it might then possibly be necessary to destroy the lachrymal sac, and perhaps to remove the lachrymal gland, though I have never had to perform an operation of the kind for cases of this description.

*Treatment.*

Destroy the sac.

INFLAMMATION OF THE INTERNAL ANGLE OF THE EYE.—An abscess in this situation may lead to the erroneous supposition that the sac itself is involved in the mischief. That such cases occur is certain, for we see abscesses form and burst in this situation without the lachrymal apparatus being in any way compromised. In instances of this description, the abscess comes on without any symptoms of previous disease of the lachrymal sac; the inflammation sets in suddenly, and is not uncommonly attended with erysipelas, especially if the patient is in a weak state of health. The eyelids become much swollen, and lachrymation may exist from pressure of the abscess on the lachrymal sac. After a few days suppuration occurs, and the abscess points; a small quantity of pus escapes, and in a short time all traces of the disease disappear.

Inflammation of the Angle of the Eye, simulates abscess of the sac.

Often erysipelatous.

*Treatment.*—In the early stages of the disease we may paint the skin over the sac with a strong solution of nitrate of silver. Subsequently, if suppuration has taken place, the abscess must be opened and poultices or water-dressing applied. The wound heals, and the parts speedily return to their normal condition.

*Treatment.*

Arg. nit.

Poultices.

## CHAPTER VI.

## DISEASES OF THE SCLEROTIC.

*Hyperæmia—Episcleritis—Ulceration—Sclero-choroiditis anterior—Wounds and Injuries—Tumours.*

Hyperæmia.

HYPERÆMIA OF THE SCLEROTIC.—When describing the anatomy of the eye, p. 4, I mentioned that the conjunctiva is supplied with a superficial and deep set of vessels, and that these form a ring of anastomosis round the circumference of the cornea, from which vessels are given off, which perforate the sclerotic and anastomose with those of the iris and choroid.

The "Sclerotic zone."

This latter set of vessels is known as the "sclerotic zone of vessels," or "the arthritic ring;"* which is situated in the subconjunctival tissue; it is frequently made apparent by congestion, when the circulation in the internal structures of the eye is deranged, and so it becomes an indication of the vascular condition of the intra-ocular circulation (*see* Fig. 2, Plate 1). Unless, however, in diseases of the cornea, iris, or choroid, the congested "sclerotic zone" is seldom seen: if, therefore, we are to consider the appearance of the "arthritic ring" as an indication of hyperæmia of the sclerotic, we must admit that the latter pathological condition is but rarely observed in practice, except as a complication of alterations in the neighbouring structures.

Denotes intra-ocular disease.

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* The term, "arthritic ring," has been applied by some pathologists to a narrow white ring sometimes seen between the cornea and the vascular zone, and which was formerly supposed to be characteristic of rheumatic or "arthritic" inflammation. This is, however, not the case, nor has the appearance any diagnostic value.

EPISCLERITIS.—We occasionally meet with cases, especially among adult females, in which *parenchymatous formations* of a limited character take their rise in the sclerotic. A patient affected in this way presents himself to us with a dusky-red or dull purple bulging of the sclerotic, probably as large as a split pea or bean, usually situated on the inner or outer side of the globe, near the insertion of one of the recti muscles. There is generally some slight conjunctivitis over and around this little nodule in the sclerotic. The patient seldom complains of pain or inconvenience beyond a slight stiffness in the movements of the eyeball; nevertheless, in some cases, especially those subject to rheumatism, the patient complains of intense neuralgic pains extending from the affected eye over the side of the temple, with considerable photophobia. The protuberance feels hard, precisely as if a small fibrous tumour were growing from the sclerotic; the part is vascular, but the rest of the eye may be perfectly healthy; the injected conjunctiva can be moved over the upraised sclerotic.

Episcleritis.

Raised and red spot on sclerotic.

No pain.

Some of these cases may be traced to a syphilitic taint, the hypergenetic process in the sclerotic resulting in the formation of a gummy tumour of small size, pursuing the same course as similar growths do in other parts of the body, and under these circumstances the growth in the sclerotic is likely to recur after it has disappeared for a time.

"Gummy" character.

The progress of episcleritis is very slow, often lasting for several months; but it has a natural tendency to recovery, and will in time entirely disappear; but if of syphilitic origin it may degenerate into an ulcer, unless properly treated.

Progress slow.

It sometimes happens that inflammation and infiltration of the sclerotic occurs near the margin of the cornea or in the ciliary zone. There is a slight bulging of the sclerotic, which is of a violet tinge, and having enlarged conjunctival vessels over it. Extending from the inflamed area cloudy opacity and often ulceration of the cornea occurs. The disease is very apt to recur, and with each fresh attack more of the cornea becomes involved; the iris also is implicated, and in most cases the diseased sclerotic yields to the intra-ocular pressure, and a staphyloma is the result.

Sclero-corneal infiltration.

*Treatment.* Iodide of mercury.

*Treatment.*—The eye should be kept at rest with a pad and bandage, and, as a rule, iodide and bromide of potassium combined with bichloride of mercury, will hasten the removal of these parenchymatous growths. A solution of eserine applied twice a day to the surface of the conjunctiva is often useful in these cases.

Ulceration of Sclerotic.

Ulceration of the Sclerotic.—Mr. Bowman has described a peculiar form of this affection as "small, intractable ulcers of the sclerotic,"* and I have lately met with a case of this kind. The patient was in bad health, the ulcers occurred in succession in both eyes, and were situated near the cornea; they looked as though a small piece of the sclerotic had been punched out; and in the right eye they extended so deeply into the sclerotic, that ultimately it was perforated. The disease was of a most obstinate nature, and the patient suffered considerably from pain in the eyes, intolerance of light, and profuse lachrymation. In addition to these doubtful cases of syphilis, gummatous ulcerations of the sclerotic are occasionally met with.

Anterior Staphyloma.

Anterior Staphyloma of the Sclerotic, or Sclero-Choroiditis Anterior.—By this term is understood a bulging outwards of a limited portion of the sclerotic, either close to the junction of the cornea, over the ciliary region, or near the equator of the globe. A staphyloma is said to be "partial," when only a portion of the sclerotic between the cornea and equator of the eye is involved; it is "complete" when the whole circumference of the globe is involved, the diseased action being in the majority of cases confined to the region of the ciliary body. In the complete form of anterior staphyloma, the sclerotic is extensively degenerated, and yields before the intra-ocular tension.

Thinning and bulging of sclerotic.

Causes and varieties.

Anterior staphyloma of the sclerotic may arise :—1st, From degenerative changes, the result of iritis involving the vessels and fibrous tissue of Fontana's space (p. 8). 2nd, From in-

* Bowman, "Parts concerned in Operations on the Eye," Appendix, p. 109.

flammation of the ciliary body and iris. In this case the sclerotic in the immediate vicinity not only suffers directly from the effects of inflammation, but also from faulty nutritive changes and secondary degeneration, in consequence of the disease of the ciliary body. 3rd, A staphyloma may arise from the effects of an incised wound over the region of the ciliary body or choroid.

1. Degenerative.

1. In the first class of cases the conditions leading to a staphyloma are gradually established, commencing with disease of the iris and fatty degeneration of the tissues at the line of junction of the cornea and sclerotic.

Vascular atrophy.

Gradual wasting of sclerotic.

The sclerotic is largely dependent upon the vessels of the choroid, ciliary body and iris for its nourishment; and so inflammatory changes lead not only to atrophy of the diseased tissues but to secondary changes in the sclerotic, which is no longer able to resist the intra-ocular pressure, and bulging outwards, forms a staphyloma (Fig. 29). The size of the protuberance depends upon the extent of the degenerative changes that have taken place.

FIG. 29.

Staphyloma formed.

Dark grape-like protuberance.

A staphyloma of the sclerotic thus formed is generally of a dark bluish colour, often almost black, on account of the pigment cells of the ciliary body having become intimately attached to its inner surface, and their colour being seen through the attenuated sclerotic. This form of disease often makes but slow progress, and may become stationary; but if irritation and congestion are excited in the neighbouring structures, the parts already prone to disease undergo further changes, and a large staphyloma results. In this case the nutrition of the vitreous and lens is apt to suffer, the former becoming fluid and flocculent, the latter more or less opaque, so as greatly to interfere with the perfection of vision.

Progress slow or arrested.

Vitreous and lens degenerate.

2. Inflammatory.

2. In instances of anterior staphyloma of the sclerotic originating in inflammation of the ciliary body, precisely the same pathological changes ensue as in the previous variety. The early symptoms, however, are those of irido-cyclitis; the congested sclerotic zone of vessels exists, indicating abnormalities

Begins as irido-cyclitis.

in the intra-ocular circulation; there is pain in the eye, increased on pressure over the inflamed ciliary body, and intolerance of light; haziness of vision from opacity of the vitreous follows; and there is marked increase of tension of the eyeball. The symptoms often run a subacute course; but from effusion taking place into the part, the ciliary body is apt to be torn away from the sclerotic; or from damage done to its vessels during the inflammation, degenerative changes progress rapidly in the latter structure, and, as I have above described, it yields to the intra-ocular pressure, and a staphyloma occurs. This bulging of the sclerotic may be of very considerable size, so much so as ultimately to project forwards between the eyelids and impede their movements, or even prevent their closing. In instances of this kind the retina becomes detached, and the eye totally destroyed. On the other hand, if the staphyloma does not reach any very considerable size, and a sufficient quantity of healthy choroid is left to supply nourishment to the vitreous and lens, the patient may retain a fair amount of vision for a time; but in too many cases of this description exacerbations of the disease occur, ending in destruction of the eye.

Secondary degeneration of sclerotic.

Staphyloma.

Sight may be lost.

3. Traumatic.

Ciliary hernia.

3. In instances of wounds of the sclerotic over the ciliary region a hernia of a portion of the ciliary body may take place through the incision, and unless the case is speedily brought under treatment, the intra-ocular pressure not only forces the edges of the wound apart, but protrudes more of the ciliary body through it. This extruded portion becomes in the course of time covered by fibrous tissue, so that a staphyloma is formed, the inner surface of which is lined by the remains of the ciliary body or choroid, according to the position of the original wound. In consequence of the irritation and stretching to which the parts are exposed, subacute inflammation is established, and progressive degenerative changes set in; more of the sclerotic may, in this way, be involved, until at last a large staphyloma is formed.

Adventitious coating.

Resulting staphyloma.

In instances of this description, unfortunately, the damage is not confined to one eye—the irritation is too frequently propagated from the injured eye to the sound one, and unless the

Implication of the other eye.

source of irritation is speedily removed, the patient will lose his sight altogether.

From whatever cause a staphyloma of the sclerotic may arise, it follows, if the protrusion be a large one, surrounding perhaps the whole or a greater part of the circumference of the eye, that extensive changes occur within the globe. We must bear in mind the fact that staphylomas involving the sclerotic round the margin of the cornea implicate the spaces of Fontana, which is the chief region of filtration of the intra-ocular fluids; hence, we notice in cases of this kind that the iris becomes altered in colour, the lens often opaque, the vitreous degenerated. In fact, glaucomatous changes occur, and in many cases the eye thus affected becomes completely disorganized; on the other hand, staphylomas posterior to the ciliary region (if the consequence of a limited choroiditis) are less likely to lead to destructive changes in the eye than those which implicate the spaces of Fontana.

Deep-seated changes.

*Treatment.*—In the degenerative form of anterior staphyloma of the sclerotic, but little can be done to cure the disease. Much may be effected, however, in the way of preserving the eye from further damage, by warning the patient of the danger he runs from over-exerting it, and of the necessity there is for protecting it from external injury and from the glare of the sun, and, in fact, of taking all possible care of the diseased organ. If the affection depends upon inflammatory changes, our treatment must be mainly directed towards the mitigation of the primary cause of the disease; and as a means to this end we shall probably resort, among other measures, to paracentesis or iridectomy; but for further details on this subject I would refer to the chapter on irido-cyclitis. If, in instances of this description, the staphyloma is of considerable size, and the sight of the eye destroyed, there can be no two opinions as to the propriety of excising the diseased globe.

*Treatment.* Rest and protect the eye. Subdue inflammation. Abscission; when expedient.

In the third class of cases of staphyloma of the sclerotic resulting from an incised wound, whether of recent origin or otherwise, if the patient's sight is much impaired, the sooner excision of the eyeball is performed the better. Sympathetic irido-choroiditis, as I have elsewhere explained, is a most insidious and dangerous form of disease, and is what we have most reason

If traumatic. Sympathetic irido-choroiditis.

Endangers sight.

to fear in cases of sclero-choroiditis arising from wounds of the sclerotic. I have no hesitation, therefore, in saying that, even supposing the sight of the injured eye is partially retained, but the vision of the sound eye gradually becomes impaired, or symptoms of irritation in the iris or deeper structures make their appearance, extirpation of the injured organ must be insisted on at once; any delay, under these circumstances, may end in total loss of sight in both eyes. On the other hand, by removing the diseased eye before sympathetic irritation has been excited, we may reasonably hope to prevent the sound eye becoming blind.

Necessitates immediate extirpation.

Wounds of Sclerotic.

WOUNDS OF THE SCLEROTIC.—Incised wounds of the sclerotic are not uncommon. An injury of the kind is apt to be complicated with prolapse of the choroid or ciliary body into the wound. The retina, under these circumstances, is generally torn through, and a portion of the vitreous escapes; the prolapsed structures get entangled in the wound, and as the latter cicatrizes and contract, sympathetic irido-choroiditis is established in the other eye, necessitating the removal of the wounded eyeball.

Retina involved in the cicatrix, And displaced.

Rupture of Sclerotic.

RUPTURE OF THE SCLEROTIC may occur from a direct blow on the eye, inflicted with a blunt instrument, the closed fist, or from a fall. In cases of this description, the sclerotic is most commonly burst open at its upper or inner part, near the margin of the cornea, or between the cornea and the insertion of the recti muscles.

A blow on the eye, sufficiently severe to rupture the sclerotic, necessarily affects the other structures contained in the eyeball, and at the instant when the sclerotic is ruptured, the lens is usually forced out through the wound, dragging the iris, and often a portion of the choroid, away with it. The vitreous may also escape, and, in fact, the eye too often collapses, and is totally lost. In less severe cases the retina may be detached from the effects of the concussion, or from the bursting of some of the choroidal vessels, and the hæmorrhage which then takes place behind it. Under these circumstances, the anterior and vitreous chambers become filled with blood,

Escape of lens, and vitreous.

Retina detached.

Hæmorrhage.

and it will be impossible to ascertain exactly the lesions that have taken place in the fundus of the eye until the blood has become absorbed. Lastly, during and after the healing process there is always great danger of sympathetic irritation being excited in the sound eye, in consequence of the prolapsed tissues becoming adherent to the cicatrix of the wound in the sclerotic.

CONTUSIONS of the sclerotic, apparently of a trivial nature, are at times followed by degenerative changes in the vitreous. Probably, the circumstance of the injury is forgotten, and the patient consults the practitioner for gradual loss of sight, usually complaining also of dark objects waving about before the field of vision. On examining the eye with the ophthalmoscope, we not unfrequently find partial detachments of the retina, and that the vitreous is fluid; small brown or black specks may be seen floating about in it whenever the patient moves his eye.

Contusions.

Vitreous may become fluid.

*Prognosis.*—The prognosis to be formed in instances of severe wounds or injuries of the sclerotic, is, as a rule, unsatisfactory. Even in slight cases, complications such as above indicated, consisting of detachment of the retina and degeneration of the vitreous may occur. Lastly, injuries of this description are likely to involve the choroid, entailing remote ill-consequences, as I shall subsequently explain when speaking of diseases of that structure.

Prognosis unfavourable.

*Treatment.*—In a case of rupture or wound of the sclerotic, if no great amount of the vitreous has escaped, its edges, under some exceptional circumstances, may be brought together by means of fine sutures, and the eye kept at rest till the wound has healed. But if the lens and a considerable portion of the choroid or ciliary body protrudes into the wound, the mischief does not stop here, for sympathetic irritation is so frequently set up in the other eye, that it is better to remove the injured globe at once, especially if the sight of the eye is destroyed.

*Treatment.*

Sutures in rupture.

TUMOURS OF THE SCLEROTIC.—Cases of fibroma, and sarcoma growing from the sclerotic have been described; but such tumours invariably commence in the episcleral tissue, at the corneo-scleral margin.

Tumours.

## CHAPTER VII.

### DISEASES OF THE CONJUNCTIVA.

*Hyperæmic—Muco-purulent—Purulent—Diphtheritic—Granular—Pustular Conjunctivitis—Injuries of the Conjunctiva—Hypertrophy and Atrophy—Pterygium—Relaxation—Serous and Bloody Effusions into the Conjunctiva—Tumours of the Conjunctiva—Disease of the Caruncle.*

#### CONJUNCTIVITIS.

Conjunctivitis. Classification.

THE various forms of conjunctivitis (ophthalmia) may be described under the following heads :—Hyperæmia, Muco-purulent, Purulent, Diphtheritic, Granular, and Pustular Conjunctivitis.*

Transitional forms.

It is difficult, in the first three of these affections, to draw a line of demarcation between the commencement of one form of disease and the termination of that preceding it ; thus, muco-purulent conjunctivitis is always preceded by hyperæmia, and purulent conjunctivitis by both hyperæmia and muco-purulent conjunctivitis ; yet, practically, the distinction will be found both natural and useful. The symptoms of diphtheritic, granular, and pustular conjunctivitis are sufficiently well marked to distinguish them from one another, and also from the first named affection of the conjunctiva.

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* It seems to me hardly wise to retain the word *ophthalmia* to designate diseases of the conjunctiva ; we employ the terms iritis, choroiditis, and so on, to signify inflammation of the iris and choroid ; why not, therefore, conjunctivitis in analogous diseases of the conjunctiva ?

Other forms.

I shall give no special description of the purulent conjunctivitis of infants, or of gonorrhœal conjunctivitis; these may well be included under the general head of purulent conjunctivitis; and it seems to me simply complicating a rather difficult subject, to split it up into unnecessary subdivisions. And so again with regard to the exanthematous forms of the disease—those, namely, which are often met with during the progress of measles, scarlatina, or small-pox—they are to be treated upon exactly the same principles as ordinary hyperæmia, or muco-purulent conjunctivitis. The so-called *catarrhal* conjunctivitis, in its milder forms, is described under the heading of hyperæmia of the conjunctiva; in more severe cases the disease assumes the characters of muco-purulent conjunctivitis.

HYPERÆMIA OF THE CONJUNCTIVA—I have already described the healthy orbital conjunctiva as a transparent tissue, through which the white and glistening sclerotic may be seen; on everting either the upper or lower lid, a number of small reddish streaks may be traced beneath the conjunctiva, extending backwards from the margin of the lids; they mark the position of the Meibomian glands, and as they are situated beneath the mucous membrane, it follows that if the conjunctiva is congested, these reddish streaks will be more or less concealed.

HYPERÆMIA.

Appearance of the parts.

Meibomian glands hidden.

In hyperæmia we shall notice, on everting the lids, that the palpebral conjunctiva is not only injected, but that its surface is no longer smooth. This arises from two causes,—first, its villi become prominent from the turgid state of the vessels which they contain; and secondly, its glands are thrown into increased activity, and become enlarged; these, together with the swollen villi, give the mucous membrane a rough appearance, particularly on the tarso-orbital fold, which is also somewhat swollen from the serous effusion poured out into its loose cellular tissue. The eyelids, caruncle, and semi-lunar folds are also somewhat swollen. The orbital conjunctiva is only slightly affected in simple hyperæmia; it may be that its superficial vessels are congested, in which case they are seen coursing over the sclerotic in a reticulate manner towards the cornea.

Palpebral part red and rough.

Villi turgid, glands large.

Conjunctival and scleral congestion contrasted.

*Symptoms.*—Congestion of the orbital conjunctiva can hardly be mistaken for that of the subconjunctival tissue, if the following points be kept in view :—In the former, the enlarged vessels may be readily made to glide over the surface of the sclerotic by gently pressing upon, and moving the mucous membrane under the point of the finger ; the vessels of the congested conjunctiva again are most marked towards its palpebral fold, and generally decrease in number and size as they approach the cornea ; the larger vessels, moreover, are separate and distinct from one another, and are of a bright scarlet or vermilion colour. On the other hand, hyperæmia of the subconjunctival tissue is always most marked immediately around the margin of the cornea, the vessels being of so minute a size, that they cannot be distinguished from one another ; the part appears as though it had been stained of a delicate violet or pink, the intensity of the colour decreasing about two lines from the margin of the cornea, and being gradually lost in the normal whiteness of the sclerotic. We do not often meet with cases of hyperæmia of the subconjunctival tissue without the conjunctiva being also somewhat congested, so that in the majority of instances the contrast between the two is sufficiently marked to attract the attention of even a casual observer.

Pain not great.

Sensation of grit.

Less in the aged.

The amount of uneasiness to which hyperæmia of the conjunctiva gives rise, seldom amounts to anything more than a sensation as if sand or grit had fallen into the eye, caused by the constant rubbing of the congested vessels of the mucous membrane against the surface of the cornea. This symptom is apt to vary with the age of the patient, being less marked in old persons than in the young, on account of the muscular fibres of the orbicularis losing their contractile power, and pressing the lids less firmly against the eyeball in the case of elderly people. Under these circumstances, considerable hyperæmia of the conjunctiva may exist, without the patient feeling any inconvenience whatever from it, because the lax state of the parts admits of considerable vascular engorgement, without any equivalent increase of the mutual pressure between the lids and the globe.

Bright light distressing.

In cases of hyperæmia, if the patient is exposed to the glare of the sun or lamplight, or is overworked, it causes a feeling of

weariness and irritation in the eye. The secretions from the lachrymal and conjunctival glands are increased in quantity, but are not altered in character; the disease is consequently non-contagious, but the patient complains of his eyes watering a good deal. This symptom is due to the congested state of the mucous membrane of the lids, which extends to the lining membrane of the puncta and canaliculi, and the natural passage of the tears into the nose being plugged, they collect in the inner corner of the eye, and overflowing, induce the lachrymation complained of.

Secretions increased.

Puncta closed.

Lachrymation.

*The Causes of Hyperæmia of the Conjunctiva* are numerous: in the tropics the glare of the sun combined with the state of the atmosphere, which is often loaded with dust, and among the lower order of natives, with the smoke from the wood-fires, over which they cook their food, together with miasmatic influences, the fumes of ammoniacal gases, exhalations from open cesspools, and all manner of putrescent filth—all these are constant sources of irritation and hyperæmia. In colder climates no more common cause for simple conjunctivitis exists than sudden changes in the temperature of the atmosphere inducing a "cold."

*Causes.*

Glare.

Smoke.

Exhalations.

The presence of a foreign body on the conjunctiva may also give rise to congestion of the mucous membrane. Under this head we should place those cases in which an inverted eyelash, by brushing against the eye, keeps up persistent irritation and hyperæmia.

Foreign bodies.

Disease of the retina may, by reflex action, cause congestion of the conjunctiva; and among hypermetropics, the accommodating power of the eye is overstrained, and hyperæmia of the conjunctiva frequently results. Lastly, congestion of this membrane may arise from a faulty state of the digestive and secreting organs.

Disease of retina.

Hypermetropia.

Disordered digestion and secretion.

*The treatment* of this affection should be directed towards the removal of the cause of the disease; for instance, the eye may be protected from the glare of the sun, or from dust, by neutral tint glasses. Astringent lotions, composed of one to two grains of sulphate of alum to an ounce of water should be applied to the surface of the everted lower lid two or three times during the day. In chronic cases, at night the patient should be

*Treatment.*

Remove cause.

Protect the eye.

Astringent lotions.

Directions for use.

Ointment. directed to smear an ointment along the free edges of the affected eyelids :—Ung. hydr. ox. rubri dil. ℥ss ; vaseline, ℥ss.

Atropine often useful. Astringent lotions in some cases excite irritation and pain in the eye ; under these circumstances it is not advisable to persist in their use, but a weak solution of sulphate of atropine, gr. $\frac{1}{16}$ to the ℥j of water, should be dropped into the eye once a day. We may order the patient to use the cold-water douche to the closed eyelids, for ten minutes, night and morning. Cold compresses are also refreshing, and may be applied over the lids, with advantage, for fifteen minutes at a time, especially after a day's work.

Cold douche and compresses.

Rest. When the hyperæmia depends on overstraining the eye, our first care must be to protect the organ by rest, and ordinarily fair usage ; our eyes can hardly stand with impunity all the wear and tear that we, of this restless age, are apt to force upon them.

Alteratives. Abstinence. If the affection is associated with visceral disorder, alteratives, and similar remedies ; frequently abstinence, as regards tobacco and alcohol, must be enjoined, and a dose or two of blue pill administered. These means are as often required in one class of cases as tonics are in another.

Tonics.

Remove foreign body. It is almost superfluous to remark that, if hyperæmia depends on the presence of a foreign body in the eye, the offending substance must be removed : if an inverted eyelash, for instance, it must be carefully extracted. In examining an eye, never forget to glance at the cilia, particularly at those growing near the inner or outer angle of the eye : a single hair may be sufficient to keep up such an amount of hyperæmia, as to render a patient unfit for ordinary work, and unless the offending object is removed, the disease will certainly persist.

Glasses for hypermetropia. Hyperæmia of the conjunctiva, depending on hypermetropia, may be cured by a proper selection of convex glasses, adapted to relieve excessive effort of accommodation : this subject, as well as that of congestion depending on retinitis, will be more fully treated of in a subsequent chapter.

Catarrhal Conjunctivitis. MUCO-PURULENT, OR CATARRHAL CONJUNCTIVITIS (Plate I. Fig. 1), may be considered as an aggravated form of hyperæmia, with this difference, however, that the discharge from the

conjunctiva, though still consisting chiefly of a watery fluid, contains albumen and shreds of muco-purulent matter; and further, that the muco-purulent matter possesses *contagious* properties; in this respect, therefore, the disease we are considering differs from simple hyperæmia. Contagious.

*Symptoms.*—In the early stages of muco-purulent conjunctivitis, we shall find that the vessels of the palpebral conjunctiva are principally affected, so that the position of the Meibomian glands is speedily concealed by the congested mucous membrane covering them; the inner surface of the lids appears of a uniformly red colour, the conjunctiva being slightly swollen, especially at the tarso-orbital fold and caruncle. As a general rule, both eyes are equally affected. The vessels of the orbital conjunctiva are occasionally affected to such an extent, that the sclerotic is entirely hidden by the uniformly red and congested mucous membrane covering it. Under these circumstances, there is generally a good deal of *chemosis*—a term employed to indicate an œdematous condition depending on serous infiltration of the sub-mucous connective tissue of the conjunctiva. In the majority of instances, however, the vessels of the orbital conjunctiva are not so deeply injected as above described, but many large and separate vessels may be seen coursing over the sclerotic in a reticulate manner, from the palpebral conjunctiva towards the cornea.

Palpebral portion red and swollen.

Orbital portion injected.

Chemosis.

The amount of chemosis present varies in different cases; in some cases it bulges the conjunctiva forwards, and causes it slightly to overlap the margin of the cornea. To the same cause—viz., over-distension of the vessels, we must attribute the patches of ecchymosis seen on both the palpebral and orbital conjunctiva, in cases of muco-purulent conjunctivitis.

Ecchymosis.

The secretion from the lachrymal and conjunctival glands varies in character during the different stages of the disease; at the commencement it is augmented in quantity, but is normal in quality. As the congestion increases, the circulation through the vessels is impeded, and the first effect of this, observed in the secretion, is the presence in it of albumen; afterwards, as increased cell-formation is established in the epithelial layers of the conjunctival and conglomerate glands, we find a vast number

Secretion augmented; becomes albuminous.

of epithelial, together with mucous, cells mixed up with the serous fluid which escapes from the eyelids. This muco-purulent matter usually collects in whitish flakes, which may generally be seen floating about in the tears, not mixing with them; and when the lower lid is everted, the latter escape, and the flakes of mucus generally become deposited on the surface of the conjunctiva, especially on the tarso-orbital fold.

Meibomian glands affected.

The diseased action is not confined to the conjunctiva and lachrymal apparatus; after a time, the lining membrane of the Meibomian glands also participates in the irritation going on in their immediate vicinity; their secretion becomes altered in character, as well as increased in quantity, and accumulating on the margin of the lids during sleep, it dries and gums them together, so that, on waking, the patient has often considerable difficulty in opening his eyes, until they have been washed, and the concretions removed. The patient complains of a sensation as if grit or sand had fallen into his eye, and it is often difficult to persuade him that this symptom does not depend upon a foreign body lodged beneath the lids; the affected eye itches a good deal, and the upper lid feels to the patient as if it were stiff and heavy, especially after work or exposure to the glare of the sun or candle-light.

Lids cohere.

Sensation of grit in the eye.

Stiffness of the lids.

Prognosis.

An attack of conjunctivitis of this kind usually disappears in the course of a few days, unless its exciting cause should continue in operation; under which circumstances it may pass on into the purulent or other forms of inflammation, or it may degenerate into a state of chronic hyperæmia.

*Causes.*

*The Causes* which induce muco-purulent conjunctivitis are numerous, but in the majority of cases it may be traced to atmospheric influences, such as cold or damp, or sudden changes of temperature. These are, however, not sufficient to account for the sudden outbreaks of this complaint, which often has an epidemic prevalence, doubtless contagion plays an important part in the propagation of the disease, and it often spreads in this way through a school, a regiment, or a community. Miasma, foul air from overcrowding, putrescent and irritating exhalations from drains and cesspools, are also sources of this form of conjunctivitis, and greatly aggravate its progress.

Atmospheric influences.

Contagion,

and miasma.

Foreign bodies lodged on the conjunctiva may give rise to muco-purulent conjunctivitis ; for instance, an insect finds its way into the eye, and becoming impacted in the folds of the conjunctiva, induces muco-purulent inflammation. Lastly, a muco-purulent conjunctivitis is apt to occur in the course of the various exanthemata. Foreign bodies.

*Treatment.*—The first object to be kept in view in the treatment of muco-purulent conjunctivitis, is to remove, if possible, the cause of the disease. As a general rule there can be no difficulty in accomplishing this, should the inflammatory action depend on the presence of a foreign body ; but if it be induced, as it too frequently is, from the prolonged action of dust, foul air, over-exposure to the sun, or other irritating causes, it may be difficult, especially among the lower classes, to protect them from these deleterious influences. *Treatment.* Remove the cause.

In treating these cases, we should never overlook the fact that the affection is a contagious one, and therefore it is our duty to isolate patients suffering from it, as far as possible. The state of the patient's general health must be taken into consideration ; the secreting organs will frequently be found at fault, and a little judicious starving in some cases, together with a blue pill, black draught, and colchicum, will do wonders, particularly if the individual is the subject of a rheumatic or gouty diathesis. There can be no greater mistake than to order a patient astringent lotions to drop into the eye simply because he is suffering from muco-purulent conjunctivitis ; applications of this kind do far more harm than good in many of these cases. If the patient suffers from ciliary pains and irritability of the eye, it is advisable to keep him in a dark room, and apply the extract of belladonna freely over the eyelids. A weak solution of sulphate of atropine may be advantageously dropped into the eyes in cases of this description. Hot poppy-head fomentations are often most grateful to the patient, and may be employed three or four times a day, the belladonna being smeared over the lids after the use of the fomentations. Segregation. Alteratives. Belladonna.

So soon as the irritation has subsided, and the discharge from the eye is of a muco-purulent nature, astringents may be substituted for the atropine drops. A lotion composed of two grains

of sulphate of alum to the ℥j of water, should be applied to the surface of the conjunctiva three times a day. Should the discharge from the eye be copious when we first see the patient, or become so after treatment such as above indicated, we must employ a solution of nitrate of silver, containing two grains to the ℥j of water, to the eye every six hours. Cold compresses should be kept over the closed eyelids for some time after each application of the astringent lotion.

Ointment to the lids.

It is advisable, under any circumstances, to order the patient to smear a little vaseline along the free margin of the lids at bedtime, so as to prevent them from sticking together during sleep. I need hardly add that, if practicable, the patient should abstain from work, and keep away from bright sunshine; neutral tint glasses, or a gauze shade, should be worn when he is exposed to glare or dust.

Rest and protection.

Purulent Conjunctivitis, varies in severity.

Purulent Conjunctivitis.—This formidable disease varies much in intensity in different individuals and in different places; it is most destructive among the poor and ill-fed, and those whose constitutions have been impaired by disease; but under any circumstances it too frequently ends in sloughing of the cornea, and partial, if not total, destruction of sight.

It is impossible, as I have before remarked, to draw a line of demarcation between the termination of muco-purulent and the commencement of suppurative conjunctivitis, the latter being simply a more intense form of disease than the former; but in its first stage it would be impossible, in any given case, to say positively if the inflammation would advance to suppuration or not, although in the majority of instances all doubts on the subject will be cleared away in the course of a few hours. In fact, in cases arising from the inoculation of gonorrhœal or other contagious matter into the eye, symptoms of intense inflammation declare themselves very rapidly, and leave us no room for doubt as to the formidable nature of the disease with which we have to cope.

Hyperæmia at first.

Passing into acute inflammation.

Nature of the changes in the conjunctiva.

Intimately connected with the stagnation of blood in the conjunctival vessels of an eye affected with purulent inflammation, are certain active changes set up in the part, resulting in increased cell-formation; the congestion, moreover, occasions a

considerable amount of serious infiltration into the loose connective tissue of the lids, and from these combined causes the swelling and œdema of the parts arise. The extent to which the eyelids are swollen in cases of this kind is not a safe criterion of the intensity of the disease. I have met with instances in which the eyelids were only slightly swollen, and yet sloughing of the cornea had supervened very rapidly.

Swelling of the lids variable,

In cases where the serous effusion into the connective tissue of the conjunctiva is excessive, this membrane becomes so much swollen that the lids are thrust away from the eyeball; but the fibres of the orbicularis, contracting firmly, prevent the lids from being everted for some time. The distending force from within may, however, ultimately gain the ascendency, and the lid will then be turned backwards on itself, ectropium resulting. This accident is most liable to occur in young children; their attendants are apt to evert the swollen lids, in the attempt to apply drops or lotion to the eye. The accident may not be noticed till some hours afterwards, and in the meantime the fibres of the orbicularis at the line of eversion form a constricting band, which presses firmly on the part, and impedes the circulation of blood through the vessels of the everted portion of the lid; and unless the ectropium is speedily reduced, and the parts returned to their normal position, the conjunctiva is very likely to slough, and irrecoverable injury may be done to the eye.

Chemosis.

Acute ectropium.

Risk of sloughing.

The nature of the secretion from the conjunctiva varies with the progress and character of the disease; at first it is watery, then it contains muco-purulent matter, and lastly it will be found to consist of pus often tinged with blood. There can be no doubt as to the contagious nature of the pus in purulent conjunctivitis.

Secretion varies with progress of disease.

Pus infectious.

*Corneal Complications.*—In severe cases of purulent conjunctivitis, the circulation in the part is impeded, on account of the blood stasis due to the inflammatory action. In addition to this, the swollen conjunctiva overlaps the margin of the cornea, and in many instances the chemosis is so great, that the cornea appears buried in the crimson folds of the mucous membrane. This effusion into the conjunctiva tends to augment the impediments to the circulation through its deeper layer of vessels; and

The cornea deprived of blood.

these combined causes materially interfere with the passage of blood to the margin of the cornea, leading to rapidly advancing ulceration and necrosis of that important structure.*

Consequent ulceration.

A careful examination must be made.

We cannot, therefore, be too careful in examining the eye of a patient suffering from purulent conjunctivitis, to ascertain the condition of the cornea beneath the chemosed mucous membrane. Considerable difficulty, however, is often experienced in opening the lids in cases of this kind, for not only are they frequently much swollen, particularly the upper one, but the individual involuntarily resists our attempts to admit light into the eye.

Infiltration.

The commencement of this disorganizing process is sometimes seen in a general haze of the cornea, but more commonly as a patch or patches of grey infiltration, usually situated at the periphery. The ulceration follows at the margin of the cornea, beneath the chemosed conjunctiva, and unless the swollen mucous membrane be pressed backwards, the destruction progressing beneath it may not be recognized; the diseased action, however, advances, the cornea is perforated, and prolapse of the iris occurs, the centre of the cornea, it may be, looking bright and clear to the last.

Ulceration concealed by chemosis.

Centre clear.

Circular ulceration.

In other cases, the ulcer spreading completely round the margin of the cornea, the nutrition of its central portion is cut off; it becomes hazy, necrosis occurs, followed by a rupture of the cornea, and probably the evacuation of the greater part of the contents of the eyeball. These changes apparently take place very rapidly, so that a cornea, which in the morning perhaps looked clear, in the evening is hazy, and on the following day may have sloughed away; not that the process absolutely occupies so short a time, for in all probability, had the chemosed conjunctiva been pressed backwards, and the margin of the

Rapid sloughing of the cornea.

* Professor Stellwag seems to regard the contact of the purulent virus as an accessory cause of the ulcerative process. "It is probable," he observes, "that this ulcerative process has a near causal connexion with the true purulent secretion, and that its effect on the corneal substance may be excited, or at least favoured, by a sort of decomposing action."

cornea examined, we should have found its circumference deeply ulcerated, as above described.

"Wash-leather" cornea.

In some instances of purulent conjunctivitis, suppurative keratitis sets in from an early stage of the disease : the cornea assumes the well-known and much-to-be-dreaded "moist wash-leather appearance"—a most hopeless condition of the parts, which has only to be seen once to be recognized again.

Fatty disorganization.

Lastly, in a few instances, the cornea appears as though it had been stained with a solution of carbonate of lead, being of a pinkish-white colour and semi-transparent. These changes seem to depend on fatty degeneration of the fibrous elements of the cornea, which consequently lose their tenacity, and become unable to resist the intra-ocular pressure ; the cornea then gradually gives way, and bulges forward, particularly towards the centre, which may ultimately burst, and through the rent thus made, a hernia of the iris occurs. This particular class of cases is seldom marked by very acute symptoms, the chemosis is not a prominent feature of the disease, nor is there much purulent discharge from the eye ; but these degenerative changes, gradually advancing in the fibrous structure of the cornea, indicate a serious state of things when occurring as a complication of suppurative conjunctivitis.

Rupture.

Hernia of the iris.

The patient relieved by rupture.

No sooner is the cornea destroyed by any one of the processes above noticed, than the patient experiences the greatest relief ; the intra-ocular pressure being removed, the pain at once abates, the discharge becomes less, and the patient believes that all is going on well, whereas, as Mr. Dixon remarks, the surgeon knows but too surely that his patient's sight is lost for ever. But, as he further observes, "as long as any portion of the cornea retains its vitality, the case must not be abandoned in despair ; for if only a small portion, less than a quarter of one cornea, can be saved from destruction, and its transparency retained, useful sight may be eventually gained by the operation of making an artificial pupil."*

Condition almost hopeless.

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* "A Guide to the Practical Study of Diseases of the Eye," by J. Dixon, p. 49.

*Subjective Symptoms.*—At the commencement of the attack the patient will complain of the affected eye itching a good deal, as if sand or dust had got into it; but this symptom seldom lasts more than thirty-six hours. In the second stage the chemosis and swelling of the lids are often considerable, and the pain is frequently very acute, but by no means constantly in proportion to the swelling of the parts; it depends to a great extent upon the degree to which the deeper structures of the eye are involved, and upon the temperament of the patient. The pain usually increases towards bedtime. There is always intolerance of light; and although the lids may be so much swollen that the patient cannot open them, he still prefers being in a dark room, and the moment he is brought towards the light there is a gush of tears from between the lids, and an instantaneous increase of pain in the eye. In fact, the physiognomy of a person suffering from a bad attack of purulent conjunctivitis, in its second stage, is characteristic of the disease; his countenance indicates pain and distress; he is led into your presence by a companion, being unable to see; the eyelids are more or less red and swollen, their free margins being usually of a scarlet colour, and pus is seen oozing from between them; the patient holds a handkerchief or his hands before his eyes, so as to screen them from the light as much as possible. It does not follow that both eyes are affected; but the sound one is usually kept closed, as exposure to light at once induces pain in the diseased organ.

Pain severe in the second stage.

Intolerance of light.

Physiognomy characteristic.

*Prognosis.*—In endeavouring to estimate the probable issue of a case of this kind, the condition of the cornea must chiefly engage our attention; if it is bright and clear, and no ulceration is going on at its circumference, the patient's health at the time being good, our prognosis may be favourable. If, on the other hand, ulceration has commenced, our opinion must be guarded; and if sloughing of the cornea has begun, we can give the patient no reasonable hope of recovery; he may regain some amount of sight in the diseased eye, but at best it will be imperfect.

Prognosis from the state of the cornea.

In forming our prognosis, also, we must constantly bear in mind the fact that purulent conjunctivitis is apt to relapse. A patient may apparently be on the road to recovery, when

Frequency of relapses.

suddenly a return of all the worst symptoms takes place, and his prospects of ultimate improvement become much impaired. Even in apparently trivial cases I have seen relapses of this kind occurring, which, in spite of my best efforts, have terminated in serious damage to the eye.

*Causes.* *The Causes of Purulent Conjunctivitis.*—This form of the disease is due, in the majority of cases, to contagion; infecting purulent matter from the eyes of another person, gonorrhœal matter, or the unhealthy secretions from the vagina, are capable, among other agents, of inducing purulent conjunctivitis. Insects, no doubt, may be one means of conveying the matter from the source of infection to the healthy eye.

Inoculation.

*Treatment.* *Treatment of Purulent Conjunctivitis.*—In purulent conjunctivitis our main efforts must be directed towards the preservation of the cornea. If the conjunctivitis were not the cause of ulceration of the cornea, we might almost leave it to itself, but as it is, unless we can reduce the inflammation going on in the mucous membrane, no amount of care and skill on our part can insure the safety of the cornea. In considering the treatment, therefore, of purulent conjunctivitis, I would divide the cases into two classes: the first to include the milder ones, in which the cornea is unaffected; the second, the more severe cases, in which ulceration of the cornea has already begun.*

Cases divided into two classes.

1. In the first class of cases, discarding all consideration as to the cause of the disease (unless in instances arising from the presence of a foreign body in the eye), or whether the patient be an infant or an aged person, but distinctly bearing in mind the fact that we are now discussing those cases which are not complicated with ulceration of the cornea, we should at once order a strong solution of nitrate of silver (one drachm to an ounce of water) to be painted over the skin of the eyelids. Another, weaker solution (two grains to the ounce) should also be prepared, some of which may be dropped into the eye every second hour. These drops should be continued for twenty-four hours, and it will then be advisable to repaint the eyelids with the strong solution of nitrate of silver, and to continue the drops

1. Where the cornea is free.

Paint the lids with arg. nit.

Drops of the same for eye.

* Tyrrell "On Diseases of the Eye," vol. i. p. 62.

until the congestion of the conjunctiva has subsided, and the purulent discharge become thinner, and less profuse.

In the majority of cases, it will probably be unnecessary to apply the solution of nitrate of silver over the skin of the eyelids more than twice, but the instillation of the drops into the eye should probably be continued for a week or ten days; by that time the active symptoms of the disease will almost invariably have disappeared (provided the patient has come under our treatment at the commencement of the attack), and a solution of two grains of sulphate of alum to an ounce of water may be substituted for the nitrate of silver lotion. It is seldom necessary, however, to use the nitrate of silver drops every second hour, as above directed, for more than two or three days; after that we may generally use it every six hours, and subsequently twice a day.

The latter to be used for a week or so.

In cases of this kind the patient does not usually suffer from much pain in the eye, and the poppy-head fomentation with extract of belladonna smeared over the temple will probably relieve any pain that may exist; in some cases, however, especially if the patient complains of considerable pain in the eye, a few leeches applied about an inch from the outer canthus are very beneficial. The state of the bowels should be attended to, and, as a general rule, a generous dietary allowed. Quinine and a moderate amount of stimulants, are as often called for as antiphlogistics; but the state of the pulse must be our guide in this matter.

Fomentations.

Aperients.

Tonics.

The chief difficulty with which we have to contend, in treating the purulent conjunctivitis of infants and young children, arises from their resisting our attempts to drop the solution of nitrate of silver into the eyes. The child's head must be firmly secured, and the lids gently drawn apart, and the lotion having been dropped into the eye, the lids may be allowed to close. This proceeding should be repeated three or four times, and the eyelids then bathed with tepid water, and the child allowed to rest for two or three hours, when the lotion will have to be used again in precisely the same way, the application being continued night and day, until the purulent discharge almost ceases. If it should be found more convenient (as it often is), to apply the lotion by

Management of infants.

Drops must be used.

a small syringe, or still better, a drop bottle made for the purpose, by all means let an instrument of the kind be employed. What we must insist on is that the nitrate of silver lotion is brought thoroughly into contact with the inflamed surface of the conjunctiva.

In most cases, if this plan of treatment be strictly followed out, a considerable improvement will be quickly noticed in the state of the child's eyes. Within three or four days the little patient will begin to open them, and bear exposure to the light; the swelling of the lids and congestion of the conjunctiva diminish; and we may then substitute a solution of sulphate of alum (two grains to an ounce of water), for the nitrate of silver, the drops being used three times a day. We should bear in mind the fact, that a relapse is just as likely to occur in this as in any other form of the disease, and not entirely discontinue the use of the sulphate of alum lotion until the child has perfectly recovered; and should a relapse occur at any time, and the discharge become purulent, we must resume the nitrate of silver solution, which is almost a specific in cases of this kind.

Improvement rapid.

Relapses may occur.

2. I now proceed to consider the treatment of the second class of cases—that is, those in which the cornea has become implicated, either during or prior to the commencement of our attendance on the patient. We must still rely mainly on the injection, or rather application, of a weak solution of nitrate of silver to the eye; and I strongly advocate the system of painting the skin of the inflamed lids with a strong solution of nitrate of silver, once if not twice a day, until the caustic slightly vesicates the cuticle, which it probably will do after two or three applications.

2. Cases where the cornea is involved.

The strength of the solution of nitrate of silver to be applied to the conjunctiva should be two grains to the ounce of water; the lower lid must be everted and the lotion injected into the eye by means of a small syringe, or what is better an instrument made for the purpose, consisting of a glass tube, one end of which is drawn out into a point, and the other covered over with some flexible material. If an "eye-drop" or syringe are not at hand, the lotion may be very well applied to the eye by means of a feather or camel-hair brush. The solution of nitrate

of silver should be instilled into the eye every second hour throughout the day, and as frequently as possible during the night, until the purulent discharge has perceptibly diminished; when the lotion may be used every three or four hours. I have no doubt that the sulphate of eserine instilled into the eye two or three times a day is frequently of great use in cases of ulceration of the cornea, depending on purulent conjunctivitis. The strength of the solution should be two grains of sulphate of eserine to an ounce of water.

Operation promoted by cold compresses.

M. Wecker advises the application of cold compresses to the eyelids. The compresses should be continued, if possible, without intermission, by taking pledgets of lint sufficiently large to cover the eyelids, which should be laid on a lump of ice until quite cold; they must then be placed on the lid, and changed when they become in the least warm. Pledgets of this kind should be kept on the ice in rotation, so as to maintain a constant cold surface to the inflamed eyelid.

The orbital conjunctiva should be deeply incised.

With regard to the management of the orbital conjunctiva, if much swollen and overlapping the cornea, it is advisable to make four or five incisions through the mucous membrane, radiating from its chemosed portion, which overlaps the cornea, outwards as far as the eyelids.* I would make at least four

Value of incisions.

such incisions down to the sclerotic. There can, I think, be no doubt that, by cutting through the swollen conjunctiva in this way, we relieve the pressure which the chemosis exerts, and thus give the cornea a chance of receiving sufficient nourishment to keep it alive; or at any rate of preventing the ulceration from extending.

So soon as the purulent discharge has disappeared, a solution of sulphate of alum, two grains to the ounce, may be substituted for the nitrate of silver lotion.

General measures.

The above may be considered as the special and necessary treatment for cases of purulent conjunctivitis, complicated with lesion of the cornea. We may now consider one or two points bearing on the general treatment of such cases, whether com-

* Lectures "On Diseases of the Eye," by J. Morgan. 2nd edit. p. 72.

plicated with ulceration or not; and probably one of the most important circumstances to attend to is the protection of the sound eye, if only one is affected, since the purulent secretion from the diseased eye is very apt to get into the sound one, and induce a similar disease. If, therefore, we can protect the sound eye by a pad of cotton wool and a bandage, we shall be doing the patient most valuable service. The patient himself will readily understand the advantage of this proceeding, and submit to the trifling discomfort of having his sound eye closed, so as to protect it from purulent infection.

Guard sound eye.

The pain from which many patients suffer in this disease may be relieved by the application of the extract of belladonna over the forehead, and the administration of chloral. We shall often have to use the latter drug in full doses at bedtime, for it is then that the pain generally increases, and prevents the patient from sleeping.

Relieve pain.

With regard to the application of leeches, I would simply say, that in a case of purulent conjunctivitis occurring in a plethoric individual, by all means apply six or eight leeches to the temples. But, on the other hand, no more dangerous rule can be laid down than that, because a person is suffering from pain and purulent conjunctivitis, leeches are to be applied in an indiscriminate manner. My own experience would lead me almost to reverse this rule, but in practice it will be found impossible to lay down any invariable directions on the subject. It would be as absurd to deplete a weak, anxious, and anæmic patient labouring under purulent conjunctivitis, as it would be to abstain from the practice in all cases: our common sense must guide us in the matter.

Leeches seldom useful.

Discretion in the use of depletives.

So far, however, from leeches being always useful in purulent conjunctivitis, I am inclined to think that stimulants are more often required; rum mixture, with quinine and morphia, being frequently called for, together with a generous diet; the state of the patient's pulse will be our best guide as to the extent to which this practice should be carried. In many cases the infusion of bark with ammonia will prove of the greatest benefit: should it seem to increase the pain in the eye, it may be discontinued, but if it has no such effect, it is more than probable that the patient will improve under its use.

Stimulants and tonics.

Preventive measures:

We cannot too strongly insist upon the enforcement of absolute cleanliness, and, as far as possible, segregation, among patients suffering from purulent conjunctivitis. The attendants must be strictly warned as to the danger they run from contact with the purulent discharges. Cases of purulent conjunctivitis should not be admitted into a general hospital, unless they can be isolated; and the strictest orders should then be given, that the dressing or rags employed should be burnt after use. Washing utensils, and in fact everything brought in contact with the patient, should be retained for his special use. If purulent conjunctivitis should affect a child at school, he should immediately be separated from his playfellows; and the same remark applies to soldiers, and, in fact, to collection of individuals, whether in families, schools, regiments, or any other condition of society.

Importance of segregation,

and cleanliness.

DIPHTHERITIC CONJUNCTIVITIS.

DIPHTHERITIC CONJUNCTIVITIS.—This is a comparatively rare form of disease in this country.* In some parts of Germany, however, diphtheritic conjunctivitis is prevalent, and when once a patient has been attacked with it, his chances of recovering his sight are less promising than in cases of purulent conjunctivitis.

Fortunately rare.

*Pathology and Symptoms.*—If we bear in mind the characteristic features of diphtheria in other situations, we shall readily comprehend the nature of the phenomena induced when it attacks the conjunctiva. The same tendency manifests itself here, as in the mucous membrane of the fauces and other parts of the body, for a fibrinous formation to occur, not only on the surface, but also in the connective tissue of the mucous membrane; the eyelids become swollen, hard, and brawny, so that it is with difficulty they can be everted, or, in many cases, even separated from one another, and in attempting to drag them apart we often put the patient to very great pain.

Fibrinous brawny exudation.

Conjunctiva, buff and mottled.

On examining the conjunctiva, we shall find it of a buff tint,

* See "Maladies des Yeux," par M. Wecker, vol. i. p. 70; Cyprien Raynaud, "Thesis," Paris, 1866; "Lehrbuch der Praktischen Augenheilkunde," von. K. Stellwag von Carion, p. 378, 1864, Wien.

streaked here and there with a reddish coloration, the inner surface of the lids presenting a mottled appearance. This arises from the buff-coloured fibrinous formations which infiltrate the part, exerting pressure on the vessels and stopping the circulation through their smaller branches; some of the larger vessels remain patent, while others give way, and their altered contents, staining the fibrinous formation around them, produce the mottled appearance referred to.

Not red and villous.

The contrast, therefore, between the condition of the mucous membrane of the lids, in this the first stage of diphtheria, and that of purulent conjunctivitis, is very marked: in the latter, the mucous membrane is swollen, and of a uniformly deep scarlet colour, with spots of ecchymosis scattered over its surface, the enlarged and prominent villi giving it almost the appearance of a granulating sore; whereas in diphtheritic conjunctivitis the mucous membrane is of a buff or drab colour, comparatively smooth, mottled over with superficial patches of exudation and extravasated blood, and a few large and contorted vessels are usually seen on its surface.

Exudation patches deeply connected.

If we attempt to remove any of this fibrinous formation, we shall find that it adheres firmly to the conjunctiva; we may detach it, but it breaks away in shreds, and from the jagged surface of the wound which is left, a bloody, serous fluid oozes away; the formation, in fact, is by no means limited to the surface of the conjunctiva, but exists principally in the submucous connective tissue.

The changes and appearance of the conjunctiva above described are not confined to the eyelids; the same condition exists in the mucous membrane covering the sclerotic, the fibrinous formation infiltrating the conjunctiva throughout the whole of its extent, and too often extending to the cornea.

1st stage: exudation.

The period during which the formation is being produced in the connective tissue may be considered as the *first stage* of diphtheritic conjunctivitis; it usually lasts about six days, and is accompanied with fever and great pain in the eyes, extending to the temples and head; this pain is increased if we attempt to open the eyelids, which are swollen and of brawny hardness. The temperature of the part is sensibly increased. The secre-

Pain and fever.

tion at this period is scanty and serous. As a general rule, both eyes are affected.

2nd stage: degeneration of exudates.

The *second stage* is one of reaction, degenerative changes taking place in the fibrinous exudations, which become softened and broken down. The detritus thus produced, together with pus cells from the connective tissue, and disintegrated blood

Free discharge.

corpuscles, are thrown off from the surface of the conjunctiva as a bloody, purulent discharge, containing shreds of fibrinous substance. The appearance of the everted lids is now completely altered, and nearly approaches that of the second stage of purulent conjunctivitis. The vessels are dilated and turgid with blood, the surface scarlet, but still presenting some patches

Hyperæmia.

of yellow exudation; the discharge is abundant. The patient is now almost free from pain.

The second stage varies in its duration, in proportion to the amount and depth of the primary infiltration: if this has been great, the suppurative stage will be prolonged, and the reverse if it is scanty or superficial.

3rd stage: cicatrization.

In the *third stage* of the disease, the inflammatory action subsides, and the effects of the previous changes which have taken place in the conjunctiva become apparent. Of these, the destruction of the sub-conjunctival tissues, consequent on the fibrinous formation in the part, is most obvious; and in the reparation of the damage thus done, cicatrices are formed, which, in contracting, press upon and obstruct the few remaining vessels of the conjunctiva, so that the mucous membrane may at length be entirely destroyed, and replaced by white, glistening cicatricial tissue. The duration of this stage will vary with the amount of destruction already effected; it is usually prolonged.

Prognosis unfavourable,

*Prognosis.*—From the foregoing account, it is evident that a favourable termination can rarely be looked for. If the first stage has been severe, we cannot but be extremely anxious as to the result; disorganization of the cornea is almost sure to occur, and we must frame our opinion accordingly. Even in

or guarded.

apparently mild cases, our prognosis must be guarded, for, like purulent conjunctivitis, the disease is subject to relapses, and a case which at first appeared favourable may be less so afterwards.

*Treatment of Diphtheritic Conjunctivitis.*—German practitioners advocate an antiphlogistic plan of treatment proportioned to the sthenic character of the affection—namely, the energetic application of cold to the part, extensive local bleedings, and the severest antiphlogistic regimen. Others would add the administration of mercury in large and repeated doses, so as to bring the patient under the influence of this drug as speedily as possible; calomel and mercurial inunction are, in fact, recommended *ad libitum*, and appear to be the means upon which they chiefly rely to stay the progress of the disease. They have been closely followed by other continental practitioners: thus, in the first stage of diphtheritic conjunctivitis, M. Wecker employs cold water compresses to the lids, and he also recommends the application of leeches to the temples; but above all things he insists on the administration of calomel every two hours. As soon as the patient is salivated, he affirms that the conjunctiva loses its buff-grey appearance, the second stage of the disease being speedily established. He speaks favourably, also, of the effects of tartar emetic in relieving the feverish symptoms.*

*Treatment.* Continental practice. Antiphlogistics. Mercury.

As our continental brethren have had the most experience in diphtheritic conjunctivitis, these methods of treatment demand our careful consideration, but my own experience would dispose me to adopt a different method, and one which has been very generally sanctioned both in England and America in the treatment of diphtheria.† I rely more upon large doses of the

Efficacy doubtful.

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* Dr. Pagenstecher reports on fourteen cases treated "by scarifications and the energetic application of cold in the diphtheritic, caustics and atropine in the secreting, stages. Six did badly, the rest were more or less benefited.—*Ophthalmic Review*, vol. i. p. 109.

Professor Stellwag, while fully adopting the antiphlogistic method in the active stages of the disease, rejects mercury and other reputed *antiplastics* as "absolutely and certainly inefficacious."

See also *Ophthalmic Hospital Reports*, vol. v. p. 363, where the disease is reported to have advanced rapidly, in spite of calomel.

† The American editors of Professor Stellwag's work observe: "The accepted general treatment in the United States for diphtheria in any form is the administration of iron and nutrients, *e.g.*, beef-tea, until the

Tr. ferri mur. Pot. chlor.

sesquichloride of iron and salicylic acid than on any other drugs, in the first stage of the disease: thirty drops of the tincture of iron may be administered every three hours, and this in spite of the fever which generally attends the outset of the affection. The state of the bowels must be attended to; hot baths at bedtime often induce perspiration and quiet the patient. As a general rule, a lowering plan of treatment is to be avoided; on the other hand, soup and a generous, though non-stimulating, dietary are demanded. Morphia or chloral should be given in sufficient doses at bedtime to procure the patient sleep during the night.

Nutrients.

Opium.

Local treatment.

With regard to the *local treatment* from the commencement of the disease, we may with advantage apply a lotion containing salicylic acid gr. x., tannic acid gr. x., glycerine ʒss., vaseline ʒss.; this lotion should be painted on the surface of the conjunctiva every hour.

Caustic in purulent stage only.

When once the purulent discharge has commenced, and the conjunctiva become red and vascular, the local treatment must be conducted upon precisely the same principles as I have described for the treatment of purulent conjunctivitis. A solution of two grains of nitrate of silver to an ounce of water should be dropped into the eye frequently, with cold compresses over the lids, the eye being kept scrupulously clean. We should remember always that the discharge is not only contagious, but appears to possess irritating properties, and consequently to keep up the diseased action, if allowed to remain in contact with the eye.

Cleanliness.

Astringent lotions.

In the third stage of the disease very little can be done, beyond ordering the patient a mild astringent lotion to be used twice a day, and bathing the eyes frequently in tepid water. We cannot prevent the formation and contraction of the cicatrices, which are, unfortunately, the natural consequence of the loss of tissue, following the previous destructive action of the disease.

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patient has rallied from the depression caused by the disease. We suppose this is as applicable in diphtheritic conjunctivitis as in any other form of this blood disease" (p. 325).

GRANULAR CONJUNCTIVITIS, OFTEN CALLED MILITARY OPHTHALMIA.*—This is a common form of disease, particularly among the lower classes, who are exposed to malarious and other debilitating influences. It depends upon the presence of numerous small granular bodies (Trachoma) scattered in the connective tissue of the conjunctiva, principally in the tarso-orbital fold, and sometimes in the cornea. These growths spring from the cells of the connective tissue of the part; they contain no bloodvessels or nerves, and are, therefore, utterly unlike the villi in every respect: they are, in fact, new formations, and not a mere hypertrophy of pre-existing ones, as Dr. Schmid and various other authorities hold.

Granular Conjunctivitis.

Granules not enlarged villi, but new formations.

On everting the lid of a person suffering from granular conjunctivitis, it is true that we shall, in the majority of instances, find the papillæ of the conjunctiva more or less congested and enlarged, their hue varying according to the stage of the disease. In chronic cases, the epithelium covering them becomes thickened, and they are prominent and of a dusky brownish-red hue. On the other hand, the neoplastic growths, which are characteristic of granular conjunctivitis, are most abundant on the superior tarso-orbital fold, and sometimes extend to the orbital conjunctiva where there are no villi. Frequently, however, they are so small that we must employ a lens in order that we may clearly discern them. But whether situated in the tarsal or orbital mucous membrane, they present the same appearance of small granular masses, aptly compared to millet seeds, situated immediately beneath the conjunctiva. As the disease advances, these granular bodies may increase considerably in size, and can then be distinctly seen scattered among the enlarged villi of the palpebral and orbital portions of the conjunctiva, sometimes they extend to the cornea. In the more chronic forms of the malady, owing to an excessive development of intercellular material, which assumes a gela-

Resemble millet-seeds,

* See "Maladies des Yeux," par M. Wecker, vol. i. p. 98; "Lehrbuch der Augenheilkunde," von Stellwag v. Carion, p. 385; "L'Ophthalmie militaire à l'Académie Royale de Médecine de Belgique," par le Dr. Warlomont, *Ann. d'Oculistique*, tom. xlii. 127.

tinous character, the trachoma sometimes attain the size and translucency of boiled tapioca grains—constituting the "frog-spawn" granulations of some pathologists.

or "frog-spawn."

If we examine these granular structures with the microscope in their early stages, we find that they consist of a stroma of connective tissue, containing a number of nucleated cells with a little fluid; they subsequently undergo fatty degeneration; this is also the case in those chronic forms where the cell elements are replaced by the gelatinous intercellular material already described. It is often difficult to draw a line of demarcation between the embryo elements of the connective tissue and the growths of granular conjunctivitis; but however similar in appearance, their properties are dissimilar, for the granular bodies, in place of becoming developed into connective tissue, degenerate into a fatty or other perishable substance, which is gradually absorbed, and the space which it has occupied contracting, cicatrices are left to mark its former position. It is to the existence of a conglomeration of these cicatrices, and the consequent contraction of the conjunctival tissue thus induced, that the unfavourable results of this form of disease are mainly due: the cicatrices presenting a rough and uneven surface, which, by constantly rubbing against the cornea, induces irritation and subsequently vascular opacity of that important structure.

Consist of germinal matter.

Very prone to degeneration.

Leaving cicatrices.

*Symptoms.*—Granular conjunctivitis may be described under two heads, the acute and chronic; the former may be conveniently divided into three stages.

Symptoms of the acute form.

The first stage of acute granular conjunctivitis usually lasts from eight to ten days; the patient complains of intolerance of light, and supra-orbital pains; he has a sensation as if sand or grit were in the eye, and profuse lachrymation. The margins of the lid are slightly swollen, and, on everting them, we find the palpebral conjunctiva to be congested, and a number of small, white, prominent bodies, looking like millet seeds, may be noticed embedded in the mucous membrane.* This condition

1st stage: Photophobia, pain, congestion. Granular bodies.

* Dr. H. Snellen on Diseases of the Conjunctiva: *Ophth. Hosp. Reports*, vol. iv. p. 61.

of the conjunctiva is most marked in the upper lid, and especially along the tarso-orbital fold. But the palpebral conjunctiva is not alone affected; the same condition may extend to the mucous membrane over the globe of the eye; minute white specks of a similar nature may frequently be seen in the cornea, with numerous small but easily defined vessels coursing over it, inducing a well-marked vascular opacity of this structure.

2nd stage: inflammatory.

This condition having lasted about ten days, the second or inflammatory stage of the disease commences. The conjunctiva becomes congested, and in the course of a few days a muco-purulent discharge takes place from its surface.

With sub-acute symptoms.

The muco-purulent stage of granular conjunctivitis is generally a protracted one: the patient may complain of only slight photophobia, and of little, if any, supra-orbital pain: he can open his eyes with comparative comfort and, unless the cornea is involved, can manage to see his way about. The palpebral conjunctiva, however, is intensely congested, the villi being prominent. This state of things may last for a month or more; and although the symptoms are not very acute, they are most intractable, superficial ulceration of the cornea frequently complicating the case, and too often rendering the structure opaque.

A less tractable form.

*Treatment.*

*Treatment.*—The treatment to be employed in acute granular conjunctivitis will necessarily vary according to the progress which the disease has made. We must bear in mind the fact that the inflammatory action, under these circumstances, is a curative one, and we are likely to do more harm than good by applying astringents and such like remedies to the conjunctiva. If the irritation going on in the eye is excessive, the patient should be confined to a dark room, and his eyes bathed with tepid water four or five times a day. At bedtime the extract of belladonna should be smeared over the skin of the eyelids.

Inflammation curative.

In the second stage of this affection, our treatment must be guided by the character of the inflammatory action going on in the conjunctiva, and more particularly by the condition of the cornea. So long as the cornea is free from ulceration, and there are no indications of destructive changes going on in it, we may with safety allow the conjunctivitis to run its course without any local application. The eyes must be kept clean, and poppy-

Promote second stage by fomentations, tonics,

head fomentations are often grateful to the patient, and are a means of keeping his mind employed. Tonics are generally required: soda and quinine, together with Dover's powder, may be given with advantage three or four times a day, and subsequently the chlorate of potash with the tincture of muriate of iron.

generous diet,

I would even advise these remedies, together with a generous dietary, in cases where the second stage of the disease is pursuing an active course, and much more so when the inflammatory action is languid and weak. In the latter case it will be

and cup. sulph.

well to stimulate the conjunctiva, by applying sulphate of copper to its surface once a day, until such an amount of increased action is excited as will be sufficient to destroy the neoplastic growths, which are the origin and cause of all the mischief.

*Causes.*

*The Causes of granular conjunctivitis* may, as a general rule, be traced to influences which engender an impaired state of the

Overcrowding. Bad food. Dirt.

nutritive functions. Among these, the overcrowding of human beings, together with filth, impure air, want of proper food, and in fact deficient sanitary arrangements in general, are doubtless the most prolific sources of this disease, and are capable not only of causing conjunctivitis in men, but also in the lower animals.

Prevails among the poor,

There are, probably, few people among whom granular conjunctivitis is more common than the lower orders of Irish, in Great Britain and elsewhere. The poorer classes in every part of the world, are more subject to it than their richer brethren; but local influences seem most fertile in generating the disease, and may even give it an endemic character. An instance of this kind was to be found in certain schools in Calcutta. The children in one of these schools were of different nationalities—natives, half-castes, and Europeans—but

and in unhealthy districts.

the buildings were situated in a most filthy part of the city, and were surrounded by open drains, and every conceivable abomination, and granular conjunctivitis was never absent from among the boys; whereas, in other schools of a similar nature, but situated in a healthy locality, not a single instance of the disease was to be met with.

Atropine said to cause it.

It is a remarkable fact, that the frequent and prolonged instillation of atropine to the surface of the conjunctiva appears to give rise to granular conjunctivitis; at any rate, one sees

this form of disease arising after the long-continued instillation of atropine.

CHRONIC GRANULAR CONJUNCTIVITIS.—Commences it may be without any previous acute attack, with the appearance of neoplastic growths beneath the conjunctiva. The granular bodies may be so small that we require the aid of a magnifying glass to see them. In this condition they do not necessarily give rise to any inconvenience; the patient may be unconscious of their existence, but usually complains of "sore eyes." Any slight cause, such as a disordered stomach, or over-exposure to the glare of the sun—in fact, any irritation immediately sets up an attack of conjunctivitis; the neoplasms increase in size during these periods of disturbance, and are, indeed, the immediate cause of the hyperaction going on in the conjunctiva.*

CHRONIC GRANULAR CONJUNCTIVITIS

May be latent, with active periods.

Individuals affected with this chronic form of disease are consequently liable to suffer from attacks of conjunctivitis, rendering them utterly unfit to carry on the ordinary duties of life. It is not uncommon to meet with soldiers suffering from granular conjunctivitis, particularly if serving in the tropics, the climate predisposing them to this affection; and their symptoms may be such as to lead one to suppose that they are malingering; their eyes look tolerably healthy, but as soon as they are put to any work, necessitating exposure to sun and dust, they get an attack of conjunctivitis. Cases of this description may at first sight appear suspicious; unfortunately, their termination, in the majority of instances, proves that they are of a most serious character, ending as they too often do in destructive changes in the cornea.†

Disabling character of the disease.

This chronic form of the disease may exist for years without inducing any great amount of hypertrophy of the villi; but sooner or later these become prominent, and between them patches of white cicatricial tissue are to be seen, produced by

May cause hypertrophy of villi,

* *Beale's Archives*, vol. iii. p. 201.

† Ophthalmic Surgery, by Dr. P. Frank: *Army Medical Reports* for 1860.

the degenerative changes in the mucous membrane, beneath which the granular bodies existed. The uneven surface of the mucous membrane thus produced, by constantly rubbing against the cornea, often leads to vascular opacity of that structure.

and opacity of cornea.

*The Symptoms* of chronic granular conjunctivitis have been pretty clearly indicated in the above remarks; but I may, perhaps, recapitulate them with advantage. In the early stages of the disease, the only reliable feature upon which we can depend for its identification is the presence of the minute granular bodies beneath the conjunctiva. They give rise from ime to time to attacks of conjunctivitis, the mucous membrane becoming congested, its villi more or less turgid, while the patient complains of slight pain in the eye, intolerance of light and lachrymation. After each attack of this kind, the neoplastic growths increase in size, often attaining to that of a grain of sago.

Resumé of symptoms.

This state of things may last for a considerable period, but sooner or later the material of the granular bodies disintegrates, and loss of substance thus occurring in the connective tissue of the part, the cavity closes by the formation of a cicatrix. As these minute cicatrices coalesce, patches of a dense fibrous structure form on the surface of, or rather replace, the conjunctiva. It is seldom that the whole of the tarsal mucous membrane is thus destroyed: portions of it remain, the villi having become hypertrophied, so that the everted lid presents an uneven appearance, rough velvet-like patches rising up between bands of cicatricial tissue.

The uneven surface of the conjunctiva thus produced by rubbing against the cornea, causes so much irritation, that it passes into a state of vascular opacity: or it may be that entropium is produced from an incurving of the tarsal cartilage, induced by the cicatrization of the spaces occupied by the neoplastic bodies of granular conjunctivitis. As changes in the cornea advance, the sight is more or less impaired, and ultimately the patient becomes almost blind. The disease, depending as it generally does upon constitutional causes, most commonly affects both eyes.

*Treatment.* *Treatment.*—The remarks which I have already made, on the

importance of attending to the external circumstances and hygienic conditions of patient suffering from acute granular conjunctivitis, are equally applicable to the chronic form of the disease; and unless these are carefully regulated, other treatment will be useless. Sanitary measures.

In the selection of remedies, our object must be to excite sufficient inflammation in the mucous membrane to destroy the diseased action going on in the part; and with this in view, we may smear a crystal of sulphate of copper over the conjunctiva of the upper and lower lids, every other morning, or until we have induced a considerable amount of irritation in the part, ending in suppurative conjunctivitis of a mild character.* In this way we may hope, not only to cause absorption of the existing granular bodies, but also, by having at the same time improved the patient's general health, to prevent their reproduction. Promote suppuration by cup. sulph.

Acetate of lead has been employed for the cure of chronic granular conjunctivitis. It is recommended that the powdered acetate of lead should be sprinkled over the surface of the diseased mucous membrane, once or twice a week. Liquor potassæ has been applied to the conjunctiva, and its efficacy is highly spoken of. I have tried many of the so-called specifics, but have never yet cured a case of granular conjunctivitis unless upon the principles above laid down, though I by no means assert that sulphate of copper is the only remedy which we can use under these circumstances. Any other substance which will excite sufficient inflammation in the conjunctiva to cause absorption of the granular bodies, will answer the purpose equally well. On the other hand, if the patient is placed in improved sanitary conditions, the disease may disappear of itself, unless the neoplastic growths have given rise to cicatricial tissue replacing the healthy conjunctiva. In combination with general treatment of this description, in chronic cases of granular conjunctivitis, complicated as they always are with more or less Various reputed specifics.

* M. Warlomont having tested a number of medicinal agents with a view to find a substitute for inoculation, is in favour of sulphate of copper.—*Ophthalmic Review*, vol. i. p. 186.

haziness of the cornea, equal parts of tannic acid and iodoform dusted on to the conjunctiva of the affected eye once or twice a day affords the patient relief. The operation of peritomy is sometimes attended with favourable results, as I shall subsequently explain when describing vascular opacities of the cornea.

Prevent contagious diffusion.

I need hardly say that English soldiers in the tropics, suffering from this form of conjunctivitis, should be sent to Europe. As a general rule, they are an encumbrance to the service, being quite useless as effective members of their regiments; while, at any time, active changes may be set up, and a purulent discharge established, capable of propagating suppurative conjunctivitis by contagion, and they may thus become a source of widespread mischief to their regiment.

Researches of Belgian Academy on military ophthalmia.

The following conclusions regarding military ophthalmia (granular conjunctivitis) have been arrived at by M. Warlomont, from an analysis of the lengthy discussion on this subject by the Royal Medical Academy of Belgium:—

I. Military Ophthalmia, also called contagious ophthalmia, granulous ophthalmia, &c., is an affection essentially transmissible, and subject to easy and frequent relapses. Those who have been affected by it are never sure of a perfect cure.

Propagation of military ophthalmia.

II. If it be true, as some state, that it can arise spontaneously in civil populations, it is as surely established, on the other hand, that in all the countries of Europe, where its presence has been assured, it has always commenced in the army, and spread itself from them among other classes of the population.

III. In Belgium, especially, it has been proved that before 1834 it affected the army almost exclusively. It was only after this period, and dating from the disbanding of those affected by granulations, and their return to their homes—a measure ordered by the Minister of War, on the proposition of the Sanitary Inspector-General of the Army, and sanctioned by the Commission of Inquiry and by Professor Jünken of Berlin—that its extension began among the civil population.

IV. The isolation of individuals affected with military ophthalmia in all its stages is imperatively demanded by the contagious character of the affection. Beyond this prophylactic

measure, it is not possible to retard or extirpate the disease. To send back affected patients to their homes is, therefore, a dangerous and irrational proceeding.

V. Individuals who have had this ophthalmia during their service, may be attacked afresh with it in their homes, without having been again exposed to the producing cause, and though they may have borne no traces of the disease at the time of their discharge. These relapses may take place at periods more or less distant, and science, possessing no criterion by means of which the limits of the connexion may be fixed, the disorders which are the consequence of it may be brought forward by those who have suffered from them, and urged as a claim to the assistance of the State, whatever may be the interval which has intervened between the first and following attacks.*

PUSTULAR CONJUNCTIVITIS.†—Under this head I include the "conjunctivitis phlyctenulosa" and "pustulosa," the "scrofulous corneitis" or "herpes of the conjunctiva and cornea" of some authors. PUSTULAR CONJUNCTIVITIS.

It is advisable, however, to describe phlyctenular conjunctivitis under two heads, according to the position of the vesicle or herpetic spots; in many instances they are confined to the orbital mucous membrane, and the conjunctivitis is then a very simple matter, but if the vesicle extend to the cornea, it becomes a most distressing affection. In some cases the vesicles invade both the cornea and conjunctiva at once, or they may surround the cornea like a row of beads; at other times they are situated partly on the cornea and partly on the conjunctiva. Two forms: Conjunctival and corneal.

1. With regard to that form of the disease in which the vesicles are confined to the conjunctiva. In these cases they rarely exceed two or three in number, but are apt to occur in succession one after the other, and consequently worry the First form. "Pustules" few and isolated.

* L'Ophthalmie militaire à l'Académie Royale de Médecine de Belgique, par M. le Dr. Warlomont, extrait des *Annales d'Oculistique*, tom. xlii. p. 126.

† "Maladies des Yeux," par M. Wecker, vol. i. p. 139.

patient a good deal. Each vesicle consists at first, either of a simple elevation of the epithelium by a collection of serous fluid beneath it, forming a minute vesicle not larger than a pin's head, or of an equally minute, whitish, nodular mass or pimple, on the summit of which a similar vesicle is quickly developed. These vesicles are always confined to the parts surrounding a nerve branch. The vesicles are situated on a patch of congested conjunctiva, while the remainder of the mucous membrane may present a perfectly healthy appearance. If several vesicles co-exist on the conjunctiva of the same eye, a large portion, or even the whole membrane, may appear red and inflamed; the vesicles, however, being raised above the surface of the conjunctiva, and of a whitish-yellow colour, are always sufficiently apparent against the red ground. The vesicle may become absorbed in the course of eight or ten days; or the epithelium giving way, a superficial ulcer remains, which in the majority of instances speedily heals; the congestion of the conjunctiva then disappears, and the parts return to their normal condition.*

Vesicular summits.

Congested base.

May dry up or burst.

*Symptoms.*—The symptoms to which this form of pustular conjunctivitis gives rise are usually unimportant, the patient complaining of a sensation of grit or sand in the eye, and of slight pain when the eyeball is turned in the opposite direction to the band of congested conjunctival vessels. After using the eye for a time, it begins to ache and water slightly. Unless the vesicles are situated on the cornea, the patient seldom suffers from much intolerance of light, but comes to us with his eyes wide open, complaining of the above symptoms; he will probably add that his eyelids stick together during sleep. On examining the eye, one or more pustules may be seen on or near the margin of the cornea, the conjunctiva surrounding them being somewhat congested; but with this exception, the eye appears perfectly healthy.

Sensation of sand.

Eye aches and waters.

*Treatment.*—I know of no treatment so efficacious in this form of pustular conjunctivitis, as dusting over the vesicles and congested portion of the conjunctiva with calomel, once a day.

*Treatment.*

Dusting with calomel.

* "Pathology of the Human Eye." Dalrymple, Plate XIII. description.

The calomel may be most conveniently applied with a camel's-hair pencil, and the eyelids immediately closed and kept shut for a few minutes. This application causes the patient a little pain and momentary irritation. Mr. Edgar Browne recommends finely powdered iodoform to be used in this way. The edges of the lids should be smeared with the dilute oxide of mercury ointment (one part to three of vaseline) every night before going to bed. Some surgeons recommend a weak solution of acetate of lead or zinc to be dropped into the eye two or three times a day. But independently of treatment, the tendency of the disease is to get well of itself, unless the patient be in a low and weak state of health, when the pustules are apt to appear in succession, and cause him considerable inconvenience; nor will they disappear until his general health has been improved.

Ung hyd. ox.

Improve general health.

2. In the second class of cases of pustular conjunctivitis, or, as it has been styled, herpes of the cornea, in contradistinction to that of the conjunctiva, both eyes are usually affected; the disease is most commonly met with among children from six to twelve years of age. This affection is sometimes described as scrofulous keratitis.*

2. Corneal form.

"Scrofulous keratitis."

On examining the cornea, which may be a matter of difficulty, on account of the spasmodic closure of the lids and intolerance of light which attend the affection—we shall notice several small white specks on its surface, consisting of vesicles similar to those already described as occurring on the conjunctiva; they run the same course, either their contents become absorbed, or the epithelium covering them falling off, leaves a small ulcer on the surface of the cornea. These little ulcers involving the superficial layers of the cornea, expose the terminal branches of a nerve (Fig. 2), and so the intense photophobia. The vesicles are confined, in great measure, to the superficial layers of the cornea, but the abraded surface sometimes takes a considerable time to heal, and is apt to degenerate into an unhealthy ulcer,† There is a marked disposition for a succession of these pustules

Pustules on cornea,

May leave ulcers.

* Dixon "On Diseases of the Eye," p. 95, 3rd edition.

† "Maladies des Yeux," par M. Wecker, vol. i. p. 141.

to form, sometimes for months together, rendering the complaint most distressing to the patient, and difficult to cure.

Cornea hazy.

In well-marked cases the cornea is hazy, spots of opacity, corresponding to the vesicles, being scattered over its surface; vessels may also be seen meandering over it from the conjunctival border towards the vesicles. The vessels of the conjunctiva, as a general rule, become uniformly, though not deeply, congested; the subconjunctival tissue is also involved, and its characteristic pinkish zone, surrounding the circumference of the cornea, is often to be seen.

Conjunctival and scleral congestion.

Excoriation and sores of face.

The skin about the inner angles of the eyes is apt to become excoriated, from the patient constantly pressing his hands against his eyelids to exclude the light, and from the perpetual flow of tears over the part. This excoriated state of the inner angle of the eye and lower lid often adds much to the patient's troubles; moreover, in many cases, the disease is associated with eczematous or herpetic sores about the nostrils, lips, or cheeks, and it may be with an enlargement of the glands of the neck.

But perhaps the most characteristic feature of this form of the disease are the nervous phenomena which attend it—the intense intolerance of light, and spasm of the lids. There may be also considerable ciliary pain, but this is by no means a constant symptom. The photophobia and blepharospasm are intimately associated with each other, the former being referrible to hyperæsthesia of the retina, by which a painful sense of dazzling is produced by even a feeble light; and the latter to a morbid reflex action, excited by irritation of the nerves of the cornea, causing intense hyperæsthesia of the retina of the optic nerve, or both, which is reflected through the portio dura to the orbicularis muscle. There can be no doubt that the impression of light on the retina plays a most important part in exciting this spasm, for it is greatly lessened if the patient be removed into a dark room, when he may succeed in opening his eyes; the relaxation of the muscular spasm, however, is by no means complete, and it therefore seems reasonable to infer that both the optic and fifth nerves co-operate in its production, just as in the familiar

Photophobia and blepharospasm.

Nature of the nervous phenomena.

instance of sneezing, which though generally excited through the fifth nerve, may also in this affection of the cornea be determined by a dazzling light.

It is generally possible to diagnose a case of this form of conjunctivitis, from the appearance and gesture of the patient, without even examining his eyes; he comes to us with his eyelids firmly closed, his head bent down, and a handkerchief or both hands pressed against his eyes, so as to exclude every particle of light from reaching the retina. If we attempt to force open the eyelids, a gush of tears escapes from them, and the eyeballs are involuntarily turned upwards, the patient making a desperate effort to close his lids, and sometimes sneezing violently. Physiognomy diagnostic.

*Treatment.*—Our treatment must be directed to the improvement of the patient's general health. Cod-liver oil and iodide of iron, together with nourishing food, cleanliness, and fresh air, are the class of remedies upon which we can depend. In place of giving iron, we may commence our treatment by administering a few grains of quinine combined with carbonate of soda twice a day; these drugs may be continued with advantage, together with iodide of iron. Arsenic is especially useful in cases where the disease is accompanied with eczema or other affections of the skin covering the patient's face; in instances of this description, to cure the disease of the skin is to cure the affection of the eyes. Arsenic is administered, I think, most advantageously in the form of the liquor arsenicalis, to be taken freely diluted in water, after food. The dose must vary with the age of the patient; but for an adult I generally order six minims, to be increased to ten, three times a day, until the affection of the skin and eyes begins to improve, or until the characteristic effects of the drug have manifested themselves. *Treatment.* Pure air, good food, cod-liver oil. Iron. Quinia. Arsenic.

Counter-irritation, by means of tincture of iodine painted over the skin of the lids every evening, a succession of small blisters, or what is much more effectual, an issue opened in the skin of the temple, are very useful adjuncts to the foregoing treatment. Counter-irritation.

A strong solution of atropine should be dropped into the eye twice a day; it relieves the intense photophobia. Atropine.

Belladonna.

It sometimes happens that atropine irritates the conjunctiva, in which case the extract of belladonna may with advantage be smeared over the eyebrows twice a day. The patient usually experiences great relief after his pupils have become fully dilated by means of atropine or belladonna, used as above directed. As soon as the irritation has subsided, calomel should be dusted over the surface of the patient's cornea once a day, until the haziness and vascularity covering it have disappeared. I think calomel applied in this way is preferable to the red precipitate ointment, but in the case of irritable nervous children the latter application may perhaps be more easily managed. The ointment should be applied once a day; the lower lid being everted, a small piece of the ointment is to be deposited on its surface, and the eye then kept closed for a few minutes, the lid may then be again everted and the remains of the ointment wiped from its surface by means of a bit of soft rag.

Calomel.

Exanthematous Conjunctivitis. In measles and scarlet-fever no special treatment.

Exanthematous Conjunctivitis.—With reference to conjunctivitis occurring during an attack of measles or scarlet fever, very little need be said, for in the majority of instances the conjunctivitis disappears as the disease recedes, and no treatment is required. As a general rule, poppy-head fomentations will allay the irritation which sometimes exists, and any transient intolerance of light which may occur is a symptom of no consequence, and can only necessitate the patient's being kept in a dark room for a few days. Astringents, such as alum and sulphate of zinc, do more harm than good, as a general rule, if applied to the conjunctiva; in fact, a soothing plan of treatment must be employed, and as the primary disease leaves the system, the conjunctiva will rapidly return to its normal condition. Should any complication occur, such as ulceration of the cornea, a reference may be made to the appropriate heading in the following chapter.

In variola.

In the case of variola, especially in parts of the world to which the efficient practice of vaccination has not as yet extended, the destruction done to the organs of vision by this disease is very terrible.

It does not appear that pustules occur on the cornea during the eruptive stages of the disease;* but ulceration and rapid destruction of its tissue are very apt to take place during the stage of secondary fever. This is an important fact in a practical point of view, because it hence appears less necessary to attend to the state of the eyes when the lids are intensely swollen, as they usually are in the irruptive stage of the affection, than subsequently, when the swelling has gone down, and the patient is left in a weak and exhausted condition. The eyes must then be carefully looked to, and any haziness or opacity of the cornea should be a source of anxiety to the practitioner, for it is extraordinary how rapidly destructive changes progress under these circumstances: the corneal tissue is often broken down and destroyed in the course of a few days, prolapse of the iris following, and too often the complete destruction of the eye.

Ulceration of cornea.

During secondary fever.

Often very destructive.

*Treatment.*—As a general rule, we must trust more to a tonic plan of treatment than to local means. The patient's strength should be supported by every device at our command; his eyes must be kept scrupulously clean, and the margin of the lids smeared over with vaseline at bedtime, to prevent their sticking together. A strong solution of atropine should be dropped into the eye every morning, so as to keep the pupil well dilated, especially if the cornea is already ulcerated. Should the destructive process appear to be advancing in spite of these precautions, we must puncture the cornea and allow the aqueous to escape, so as to lessen the tension of the eyeball.

*Treatment.*

Support strength.

Cleanliness.

Atropine.

Evacuation of aqueous.

XEROPHTHALMIA is a very uncommon form of disease, in which the glands of the conjunctiva lose their function, and cease to secrete sufficient fluid to lubricate the surface of the mucous membrane.

XEROPHTHALMIA.

The conjunctiva acquires a shrivelled, skin-like (cuticular) character; the cornea loses its transparency, and vision thus becomes seriously impaired. Xerophthalmia usually arises from long-continued irritation; such as that produced by granular

Dry conjunctiva.

* Article by Mr. Marson, Reynolds' "System of Medicine," vol. i. p. 444.

conjunctivitis, or from the action of foreign substances which have destroyed the surface of the mucous membrane. It may be relieved by the application of glycerine or castor-oil to the surface of the eye, but we know of no means by which it can be cured.*

Castor-oil a palliative.

## INJURIES OF THE CONJUNCTIVA.

Foreign Bodies.

Foreign Bodies on the Conjunctiva.—The form of injury most commonly presented to our notice is the superficial one, produced by a foreign body lodged on the surface of the conjunctiva. As a general rule, small patches of dust, or similar substances, which happen to find their way into the eye, cause a considerable amount of irritation of the peripheral branches of the fifth nerve, and by reflex action, a profuse flow of tears from the lachrymal gland, and this washes the offending particle out of the eye, or towards the caruncle, upon which it may often be found deposited.

Natural removal by tears,

But this process is frequently thwarted by the patient, who, after a foreign body has found its way into his eye, should seize the cilia of the lid, behind which it has lodged, and gently draw the lid forward from the globe of the eye, thus facilitating the action of the tears in washing away the offending particle. In place of this, the majority of people commence rubbing away at the lids, and in their frantic efforts to remove the cause of their suffering, drive it more firmly into the conjunctiva.

often thwarted by patient.

Should the foreign body happen to be situated on a part of the mucous membrane of the lid corresponding to the cornea, as it rubs against the latter structure during the movements of the lids, it excites the most intense irritation and pain. That it is from contact with the cornea that these distressing symptoms are principally induced, there can be no doubt, for if the particle be lodged on any part of the mucous membrane which is not so situated—as, for instance, in the oculo-palpebral fold—it may excite comparatively little irritation. So much is this the

Pain from contact with cornea.

* "Handy-Book of Ophthalmic Surgery," by J. Z. Laurence and R. C. Moon, p. 58.

case, that patients now and then come under our notice, suffering from conjunctivitis depending on the presence of a foreign body, which may have been lodged on the conjunctiva for some time, although its existence has never been suspected.*

Insects. Insects not unfrequently find their way into the eye, and may excite the most intense inflammation by their acrid secretions. The flying bug of India is a good example; it exudes some substance from its body of a highly irritating character, and it is not uncommon to meet with instances of severe conjunctivitis which have been excited in this way. Barring cases of this kind, insects, as a general rule, do not produce more irritation than other foreign bodies lodged on the conjunctiva.

Lime and other Caustics. QUICKLIME AND OTHER CAUSTIC SUBSTANCES, by their chemical action on the tissues, destroy the vitality of the mucous membrane, and a slough forming, the part can only heal by means of a cicatrix. The cicatricial tissue, in contracting, may cause entropium; or union of the palpebral and orbital surfaces of the mucous membrane may occur (symblepharon).

From time to time we meet with cases in which molten lead has run into the eye, and it is sometimes surprising to observe, how effectually the stratum of steam formed over the eye by the heated substance will protect the part from injury. But should the destructive action of the molten lead extend to the connective tissue of the conjunctiva, a slough forms, and the wound healing gives rise to a cicatrix, or to symblepharon.†

Cause cicatrices and adhesions.

The effects of lime may be confined to the superficial layers of the conjunctiva, but this is seldom the case, and it generally induces disorganization of the parts with which it comes in contact. One of the first things commonly noticed on examining the eye of a patient after lime has fallen into it, is that the cornea has become opaque in those parts which have come in contact with the lime. This haziness may subsequently clear off, but the damage done more frequently leads to necrosis of the cornea, and destruction of the eye.

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* "Injuries of the Eye, Orbit, and Eyelids," by Mr. G. Lawson, p. 3.

† See case reported by Mr. Hutchinson, *Ophth. Hospital Reports*, vol. i. p. 217.

LACERATED WOUNDS.

LACERATED WOUNDS of the conjunctiva are occasionally met with, the mucous membrane being torn open to a greater or less extent by some sharp-pointed instrument. A considerable amount of ecchymosis generally takes place in such cases, causing the patient much anxiety; but otherwise wounds of the kind are not generally of an urgent nature, and usually heal very rapidly.

Heal readily.

*Treatment.*

*Treatment of Conjunctival Injuries.*—I need hardly remark that if the injury arises from the presence of a foreign body, the offending substance must be at once removed, whether it be an insect, lime, or any other matter.

Search for foreign body, and remove it.

I have already described the method of everting the upper lid (p. 26); it is often necessary carefully to explore the whole surface of the mucous membrane, together with the tarso-orbital and semilunar folds, before we can discover the object of our search; and to add to our difficulty, the conjunctiva round the foreign body often becomes swollen and chemosed, covering in the offending substance, and completely hiding it, unless most carefully sought for. When found, there is usually no difficulty in dislodging it from the surface of the conjunctiva by the help of a needle or spud; but if very firmly impacted, it may be necessary, with a pair of scissors, to snip off the little fold of conjunctiva in which the foreign body is embedded. The eye should subsequently be closed with a light pad and bandage for a day or two.

In case of lime give chloroform.

In instances where lime has fallen into the eye, the pain it causes is often so great, that it is necessary to put the patient under the influence of chloroform before a proper examination can be made. The particles of lime must then be carefully removed, being picked off the conjunctiva with a small spatula or needle. The eye should subsequently be well syringed with warm water, the stream being especially directed beneath the upper eyelid, so as to wash away every particle of the lime.* Syringing the surface of the eye in this way is equally useful if

Syringe the surface.

* "Wounds and Injuries of the Eye," by W. White Cooper, p. 277. The eye douche of vulcanized india-rubber, with a rose jet, is recommended for this purpose.

dust or powder has fallen into it, which might otherwise be difficult to remove.

After accidents of this kind, severe inflammation of the conjunctiva and deeper structures of the eye may take place, and if so must be treated upon the principles already laid down for such cases. Hot poppy-head fomentations, together with the instillation of atropine, will be necessary. If there is much pain in the eye, a subcutaneous injection of one-fourth of a grain of morphia will afford great relief to the patient. Management of the inflammation.

When a portion of the conjunctiva has been destroyed, either from the contact of a substance such as lime, or from a burn, our first care will be to prevent, if possible, the injured orbital and tarsal surfaces of the conjunctiva from uniting; a most difficult task to accomplish, in which too frequently our best efforts are thwarted, and an intimate union between the surfaces of the mucous membrane occurs. Prevention of adhesions.

Many years ago Mr. Tyrrell inserted metallic plates between the opposed surfaces in cases of this kind, in order to prevent their union, but spoke discouragingly of the result.* Mechanical expedients.

In slight cases we should endeavour to keep the lids separated from the globe of the eye by means of a piece of lint, soaked in oil and laid between the eyeball and eyelid; but, as I have before remarked, our best efforts are generally inadequate to prevent union between the wounded surfaces of the conjunctiva. Lint dressing.

Lacerated wounds of the mucous membrane, with few exceptions, heal very rapidly, and no further treatment is necessary than keeping the lids closed with a pad and bandage for a few days. It is well, if possible, to bring the edges of the wound together with fine silk sutures.

SYMBLEPHARON, or adhesion between the palpebral and orbital portions of the conjunctiva, may be either complete or incomplete; in the latter, one or more bands of cicatricial tissue unite the opposed surfaces, and in complete symblepharon, either the upper or lower eyelid, in one or both eyes, is closely SYMBLEPHARON. Adhesion between the lids and globe.

* See article by Mr. Wordsworth, *Ophthalmic Hospital Reports*, vol. iii. p. 216.

adherent by the whole extent of its surface to the orbital conjunctiva.

Follows various lesions.

This state of things may be caused by any accident which sets up destructive changes in the opposing surfaces of the conjunctiva—as, for instance, diphtheritic conjunctivitis, ulceration, injuries, or burns involving the mucous membrane; but the contact of quicklime with the eye is probably the most frequent cause of symblepharon.

Provided the adhesions do not involve the cornea, the patient's sight is unaffected by symblepharon; but under any circumstances, he experiences more or less inconvenience from the constrained movements of the eyeball, consequent on the adhesions, and in many instances from epiphora, the puncta being more or less displaced.

*Treatment.*

If complete, operations fail.

*Treatment.*—As a general rule, partial symblepharon only should be operated on. In the complete form, unless the cornea is involved, it may be inferred from what has been already said, that we can seldom expect to improve the patient's condition by means of an operation. A variety of contrivances have been suggested to keep the surfaces of the conjunctival wound apart, but they have as a rule failed most signally.

If partial, divide bands.

With regard to partial symblepharon, the bands of adhesion may, in slight cases, be simply divided, and the extremities of the frœna separated by everting the lid frequently, say every hour during the day, and once or twice in the night, until the surface of the conjunctival wound has healed. In more extensive partial symblepharon, the bands of adhesion should be divided first of all close to the globe of the eye, the edges of the wound in the orbital conjunctiva having then been united with fine sutures should be allowed to heal. We may afterwards proceed to treat the palpebral extremities of the frœna in the same way. The lids should be frequently everted, so as, if possible, to prevent the symblepharon from again forming.

Teale's operation.

Mr. Teale recommends the following proceeding in instances of partial symblepharon, and I have on several occasions found this operation useful in cases of this kind. Mr. Teale describes his mode of operating as follows :—Having first made

an incision through the adherent lid, in a line corresponding to the *margin* of the concealed cornea (*see* Fig. 30, *a*), I dissected the lid from the eyeball until the globe moved as freely as if there had been no unnatural adhesions. Thus, the apex of the symblepharon (Fig. 31, A), being part of the skin of the lid, was left adherent to the cornea.

In the next place two flaps of conjunctiva were formed, one from the surface of the globe near the inner extremity of the raw surface, the other from the surface of the globe near its outer extremity. I first marked out with a Beer's knife a flap of conjunctiva (B, Fig. 31) nearly a quarter of an inch in breadth, and

FIG. 30.

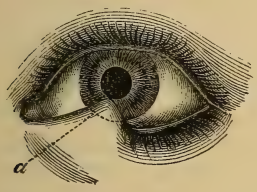
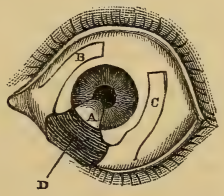
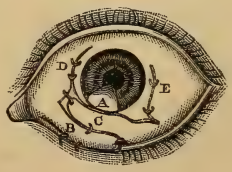



FIG. 31.




two-thirds of an inch in length, with its base at the sound conjunctiva, bounding the inner extremity of the exposed raw surface, and its apex passing towards the upper surface of the eyeball. The flap was then carefully dissected from the globe until it was so far at liberty as to stretch across the chasm without great tension, care being taken to leave a sufficient thickness of tissue near its base. A second flap was then made on the outside of the eyeball in the same manner. In making the flaps, conjunctiva alone was taken, the subconjunctival fascia not being included. The two flaps thus made were then adjusted in their new situation (*see* Fig. 32). The inner flap, B, was made to stretch across the raw surface of the eyelid, being fixed by the apex to the healthy conjunctiva at the outer edge of the wound. The outer flap, C, was fixed across the raw surface of the eyeball, its apex

FIG. 32.



being stitched to the conjunctiva, near the base of the inner flap. Thus the two flaps were dovetailed into the wound. The flaps having been adjusted in their new position, their vitality was further provided for by incising the conjunctiva near their base, in any direction in which there seemed to be undue tension, and by stitching together the margins of the gap whence the transplanted conjunctiva had been taken—*e.g.*, D, E, Fig. 32. One or two other sutures were inserted, with a view to prevent doubling in of the edges of the transplanted conjunctiva.*

## HYPERTROPHY AND ATROPHY.

Pterygium.

PTERYGIUM consists of an hypertrophy of a portion of the orbital conjunctiva and subconjunctival tissue, which is often very vascular, and has usually a triangular shape, the base of the figure being towards the semilunar fold, and the apex extending to the cornea (Fig. 33). But it by no means follows that a pterygium always spreads from the inner side of the eye; it may exist on the temporal, upper, or lower portion of the conjunctiva; its apex is usually turned towards, or rests on the cornea, in some cases extending over it so far as to interfere with the passage of light through the pupil. In other cases a pterygium, except that it is unsightly, gives the patient no inconvenience.

Wing-like hypertrophy.

Common in India.

This form of hypertrophy of the conjunctiva is common among the natives of India, and in the majority of cases begins in superficial ulceration of the margin of the cornea, the pterygium commencing at this spot, and gradually extending itself outwards. In other instances it appears to depend upon the irritation caused by small particles of sand and dust, which, finding their way into the eye, are washed by the tears along the palpebral sulcus to the lacus lachrymalis; the constant irritation thus produced leads to hypertrophy of the conjunctiva at the inner corner of the eye.

From ulcers or dust.

*Treatment.*

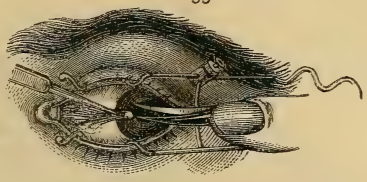
*Treatment.*—The pterygium must be dissected away from the surface of the globe. The patient having been placed under the

Dissect away the growth.

* *Ophthalmic Hospital Reports*, iii. p. 253.

influence of ether, his eyelids are to be separated with a stop speculum, the thickened conjunctiva is seized with a pair of forceps, or a hook, about midway between the semilunar fold and the cornea, and a cataract knife or a pair of scissors (Fig. 33) being passed beneath the conjunctival growth, it is to be dissected from the sclerotic as far outwards as the semilunar fold, and also from the front of the cornea, should it have extended so far; the edges of the wound in the conjunctiva should then be brought together with one or two fine catgut sutures. The success of the operation depends upon our removing the whole of the hypertrophied conjunctiva. After the operation cold-water dressing may be applied to the eye, until the wound of the conjunctiva has healed.

FIG. 33.



HYPERTROPHY OF THE CONJUNCTIVA is by no means of uncommon occurrence, following suppurative or other forms of conjunctivitis. The villous structure is principally involved, and the disease is therefore generally confined to the palpebral portion. Hypertrophy of the conjunctiva is frequently described as "granular conjunctivitis," the enlarged villi presenting much the appearance of the granulations of a wound* (Fig. 34); the distinction between them has already been insisted on in an earlier part of this chapter.

HYPERTROPHY. From inflammation.

Villi chiefly enlarged.

This affection may be complete or partial, one or both lids, or only a portion of either of them, being involved.

On everting the eyelids, the mucous membrane appears red and rough, presenting in fact very much the appearance of a healthy granulating sore. The uneven surface of the conjunctiva, by rubbing against the cornea, in the course of time may render it opaque and vascular; but this hypertrophy of the conjunctiva is by no means so frequent a cause of vascular opacity of the cornea as granular conjunctivitis.

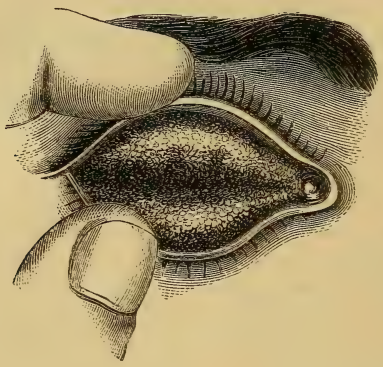
May cause opacity of cornea.

* "Lehrbuch der praktischen Augenheilkunde," von K. Stellwag von Carion, p. 404.

*Treatment.* Improve the general health.

*Treatment.*—In the majority of instances of hypertrophy of the conjunctiva, the state of the patient's general health will be

FIG. 34.



found to be at fault, and this we must improve by tonics, or other appropriate treatment, before we can hope for any amendment in the condition of the conjunctiva.

An almost incredible variety of local applications have been advocated from time to time for the cure of this affection. I recommend the following plan of treatment in severe cases:—The lids should be everted as shown in Fig. 34, and the hypertrophied conjunctiva may then be scarified, the bleeding being encouraged by wiping away the clots of blood. When the bleeding has ceased, the mucous membrane should be dried with a soft cotton rag, and a strong solution of tannic acid in glycerine may be painted over the part. This application should be used every day, and if it does not succeed in reducing the enlarged villi, we may employ a solution of chromic acid in the same way.

Scarification.

Tannic acid.

Chromic acid.

Acetate of lead.

In less severe cases, the lids having been everted, the conjunctiva may be sprinkled over with powdered acetate of lead; or sulphate of copper may be applied to the surface of the hypertrophied tissue; a crystal of the latter salt lightly drawn over the surface of the conjunctiva twice or three times a week

for a month, may prove advantageous. Tannic acid dusted into the patient's eyes every morning has been a favourite local application with many surgeons, and is no doubt often of marked service in cases of this kind.

ATROPHY OF THE CONJUNCTIVA most commonly results from diphtheritic or granular conjunctivitis; chemical agents, by destroying the tissue, may induce similar results. ATROPHY. From conjunctivitis.

The atrophied structure presents a white and shining appearance, and as a general rule occurs in patches. In consequence of the naturally smooth and soft mucous membrane being replaced by the atrophied tissue, irritation of the cornea, and ultimately vascular opacity of that most important structure, are frequently produced. The atrophied conjunctiva is further apt to contract, so that the lids are shortened from side to side, and their margins incurved (entropium). Forms white patches. Pannus and entropium.

We are of course utterly unable to restore the atrophied mucous membrane, but fortunately we may prevent or correct its baneful effects by the means I have described under the heads of entropium and vascular opacity of the cornea. No cure.

RELAXATION OF THE CONJUNCTIVA is seldom met with unless among old people, and then it occurs from the absorption of the adipose tissue of the orbit, and the sinking inwards of the eyeball, the conjunctiva being left hanging loosely from its attachments over the globe. The folds thus formed are most marked towards the inner angle of the eye. RELAXED CONJUNCTIVA. In the aged.

Astringent lotions usually constrict the conjunctiva sufficiently to overcome any inconvenience the patient may experience from this condition; but if these fail, a portion of the superfluous membrane must be snipped off; the edges of the wound unite and effectually remedy the complaint. Use astringents.

SEROUS EFFUSION taking place into the connective tissue of the conjunctiva is by no means an uncommon occurrence among old and anæmic people, suffering from a relaxed condition of the mucous membrane; it may be induced by an attack of simple conjunctivitis or some such cause. The effusion generally comes on suddenly, and the œdema may be so great that the conjunctiva bulges forwards over the cornea, having ŒDEMA. 1. Passive in the aged.

much the appearance of a yellowish, jelly-like mass; there is no purulent discharge from the eye. There is little or no pain in the eye, and although it often happens that the patient is much alarmed as to his condition, we may quiet his fears by assuring him that, beyond the slight amount of stiffness caused by the effusion, no ill effects are likely to follow.

No discharge,

or ill effects.

2. From inflammation or dropsy.

Serous effusion may, however, occur quite independently of old age, from inflammation of the conjunctiva, or of the neighbouring structures, or from remote causes—as, for instance, disease of the heart or kidneys. Excluding these cases, simple serous effusion is a matter of little or no consequence: it generally appears suddenly, and slight pressure over the lids by means of a compress and bandage causes it to disappear after a few hours. Should the œdema be very considerable, we may puncture the jelly-like mass with a needle, and allow the serum to escape, subsequently applying a pad and bandage over the eye.

Apply pressure.

Puncture.

EFFUSION OF BLOOD.

EFFUSION OF BLOOD may take place into the connective tissue of the conjunctiva, either as the result of a blow or from violent straining—as, for instance, in whooping-cough. It occurs likewise, from fracture of the bones of the orbit, and in fact from any cause by which the bloodvessels of the part are ruptured. The effused blood is at first of a deep red colour, usually disposed in blotches of greater or less extent beneath the conjunctiva, often encircling the cornea; as it becomes absorbed, various hues of discoloration are produced. It occasionally happens that the mucous membrane is slightly raised from its normal position by a clot of blood of this kind: under any circumstances, it presents a very unsightly appearance, and we are generally applied to for the relief of the disfigurement, rather than of the pain or inconvenience which it causes.

From blow or straining.

Disfiguring.

Soon absorbed.

Blood effused in this situation is usually speedily absorbed, and the process may be generally hastened by applying a compress and bandage over the eye. Should the effusion depend on the straining efforts made by a person suffering from whooping-cough, it is not likely to become absorbed until the violence of the fits of coughing has lessened; we may, however, safely relieve the minds of friends from any anxiety they may feel as to the ultimate issue of the case.

## TUMOURS OF THE CONJUNCTIVA.

ENTOZOA occasionally grow in the connective tissue of the conjunctiva; hydatid cysts,* and filaria,† have been met with in this situation. ENTOZOA.

A POLYPUS may spring from the mucous membrane of the conjunctiva, appearing generally as a small tumour, but occasionally increasing to the size of a hazel-nut. These growths are usually pedunculated, and of a light pinkish colour, soft, and in fact presenting precisely the same appearances as similar formations in the nostrils or other parts of the body, with which also they are identical in structure, Polypi in this situation cause the patient no pain or inconvenience, unless they attain a considerable bulk. They may be removed with a pair of scissors, being snipped off together with a fold of the conjunctiva from which they grow. POLYPI. Usually small. Easily removed.

FATTY TUMOURS of small size sometimes spring from the connective tissue of the orbital conjunctiva. These tumours have a yellow, unctuous appearance, and seldom cause any pain or inconvenience to the patient, except from their size and unsightly appearance. There is no difficulty in removing them. The tumour must be seized with a pair of forceps, and cut away with a fold of the conjunctiva from which it springs. The eye should subsequently be kept closed with a pad and bandage, till the wound in the conjunctiva has healed. FATTY TUMOURS. must be removed.

WARTS OF THE CONJUNCTIVA are occasionally met with. They usually grow from the surface of the mucous membrane, near the margin of the cornea, and are of a greyish colour. Their surface is smooth, and a few fine hairs may usually be seen growing from them. These small tumours should be removed, and a portion of the conjunctiva from which they grow included in the incision, otherwise they are almost sure to return. WARTS. To be removed.

CYSTS OF THE CONJUNCTIVA are rarely met with; they CYSTS.

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* "Ophthalmic Medicine and Surgery," by W. Jones, p. 685, 3rd edition.

† "Annales d'Oculistique," t. xv. p. 133.

are seldom larger than a pea, and their semi-transparent appearance, particularly when examined by oblique light, at once indicates their nature. These cysts have been known to contain hydatids.

Should be removed.

A cyst growing in this situation should be completely removed, together with the conjunctiva from which it grows.

Epithelioma.

EPITHELIOMA of the conjunctiva rarely commences on the mucous membrane of the globe of the eye, but has in many instances been known to spring from the connective tissue of the palpebral conjunctiva. I have already described the leading symptoms of this form of disease when discussing the affections of the eyelids, and it will therefore be unnecessary for me to enter further on the subject at present.

Sarcoma.

SARCOMAS growing from the conjunctiva are of rare occurrence. I lately met with an instance of this kind, the cells of the morbid growth being coloured with dark brown, almost black pigment. Several instances of the kind are recorded by M. Wecker.* Growths of this description should be excised as early and completely as possible.

Diseases of the Caruncle.

DISEASES OF THE CARUNCLE.—The caruncula lachrymalis is a small, reddish, conical body, situated at the inner canthus of the eye. It is composed of a mass of Meibomian glands, and is covered by a continuation of the conjunctiva. A few fine hairs grow from its surface.

Hypertrophy.

The caruncle participates in all the affections to which the conjunctiva is subject, and in some few cases it becomes chronically enlarged, looking like a small mass of florid granulations springing from the inner angle of the eye. Under these circumstances it may extend itself behind the upper and lower lids, and if touched is apt to bleed.

Apply tinct. opii, or cup. sulph.

Tincture of opium applied to the enlarged gland every day, by means of a camel's-hair pencil, usually effects a cure in such cases; or it may be necessary to smear it with sulphate of

* "Maladies des Yeux," tom. i. p. 199. See also a case in "Handy-Book of Ophthalmic Surgery," by J. Z. Laurence and R. C. Moon, p. 60.

copper. It is not advisable, if it can be avoided, to excise the superfluous growth, because, should the caruncle subsequently become atrophied, the lachrymal puncta are displaced inwards, and troublesome epiphora, with its consequences, occurs. Must not be excised.

A polypus springing from the caruncle should be snipped off with a pair of scissors, and the surface from which it grew touched with caustic; a little bleeding is apt to occur after this operation, but a sponge pressed firmly over the corner of the eye for a few minutes will stop the hæmorrhage.

## CHAPTER VIII.

### DISEASES OF THE CORNEA.

*Keratitis—Keratitis Punctata—Acute Suppurative Keratitis—Subacute—Ulceration—Hernia—Staphyloma—Fistula—Opacities—Vascular Opacity—Conical Cornea—Spherical Pellucid Protrusion of Cornea—Injuries of the Cornea—Abrasions—Contusions—Penetrating Wounds—Foreign Bodies—Arcus Senilis—Tumours.*

KERATITIS. Pathology.

Dr. A. ALT remarks that, from a pathological point of view, parenchymatous, pannus, phyctænular, and some forms of traumatic keratitis, must all be classed under the type of infiltration-keratitis.

Infiltration of the cornea.

"When the infiltration is confined, as is the rule, to the inner part of the cornea, the epithelium remains unaltered; it affects the lamellæ nearer the surface; the epithelium is always found in a pathological condition. It appears microscopically *in toto* irregular, and lacks its normal lustre and smoothness; microscopically, we find its cells very irregular in shape, granular and much enlarged, so that the whole of the epithelial layer covering the infiltrated portion of the parenchyma is somewhat thickened. This thickening may furthermore be due to serious imbibition, or to proliferation and new formation of cells. The corneal lamellæ surrounding the infiltrated part appear in no way altered."*

Formation of vessels.

The infiltration may be completely absorbed, and the cornea resume its normal appearance. At times, bloodvessels form

* "Lectures on the Human Eye," by Dr. A. Alt, p. 13.

from the cells or from protoplasmatic offsets (growing from the marginal vessels) which gradually become hollow, and are subsequently lined with endothelium. During the process of recovery these newly-formed vessels either disappear, or in rare cases remain persistent.

If the infiltration involves the corneo-scleral tissue, it sometimes produces sclerosis, which is erroneously called interstitial keratitis; but is in truth the result of the growth of connective tissue between the lamellæ and into the corneal canals, causing the greyish colour of these parts. Sclerosis.

*Symptoms.*—In cases of keratitis the cornea presents an opaque appearance, either throughout its whole extent, or in parts. Under any circumstances, the disease is usually more advanced in one part of the cornea than another. It generally commences towards the circumference and spreads inwards, but as it advances, the part first attacked may become transparent, while another portion of the cornea grows hazy. The diseased portion of the cornea is not only opaque, but its surface resembles in appearance a piece of ground glass. This uneven condition of the anterior layer of the cornea is best seen by the lateral method of illumination, and in fact, unless examined in this way, may be overlooked. The immediate effect of these structural changes is to render the patient more or less blind, by interfering with the transmission of light to the retina. *Symptoms.* Opacity, mostly partial. Ground-glass surface.

In the active stages of the disease, a part, if not the whole circumference of the cornea, is surrounded by a zone of injected subconjunctival vessels, similar to that seen in iritis. In addition to the "sclerotic zone," numerous minute vessels appear in the cornea, forming a semicircle at the circumference of its upper or lower section, or it may be an entire circle round the cornea. The vessels run from the margin, for about the eighth of an inch inwards, towards the centre of the cornea. By the unaided eye these small vessels cannot be distinguished from one another, and the affected margin of the cornea appears as if it had been stained with a narrow band of vermilion, or smeared with blood.* Sclerotic zone. Vessels extend into cornea.

* "Diseases of the Eye," by Dixon, 3rd edition, p. 88.

Vascularity varies with the type.

The amount of vascularity of the subconjunctival tissue and cornea will vary with the intensity and progress of the keratitis. In subacute and chronic cases these symptoms may be wholly wanting; nevertheless, the cornea presents the peculiar ground-glass appearance of keratitis. In the more acute cases the orbital conjunctiva is congested.

Dimness of vision.

The patient may complain of lachrymation, and some intolerance of light, but he is most solicitous about the haziness of vision, of which he becomes painfully conscious if the opacity extend to the centre of the cornea. It is surprising what a complete impediment to useful sight, even a slightly nebulous state of the cornea may prove, if situated directly in the axis of vision. Intolerance of light and lachrymation are not prominent features in keratitis, so long as the epithelial layer of the cornea is but slightly affected; if these cells become destroyed, and the peripheral distribution of the nerves exposed, not only does the patient suffer from photophobia, but complains also of considerable pain in the eye, and ciliary neurosis.

Photophobia and pain rare.

Prognosis.

The natural tendency of keratitis is to terminate in recovery, although the process is frequently a tedious one, extending over a period of several weeks or months, the disorder often attacking first one eye and then the other before it finally subsides, and we should warn our patients of this before undertaking the charge of the case; nor can we overlook the fact that in neglected instances of keratitis the iris may become involved, and the danger be only discovered after the cornea has cleared. We may suspect complications of this description, or even the extension of the disease to the choroid, if during an attack of apparent keratitis the patient complains of much ciliary neuralgia, pain on pressure over the ciliary body, and photophobia. Our prognosis will be far from favourable under such circumstances; but unless in these exceptional and complicated cases, the greater number of instances of keratitis make good recoveries.

Causes.

The disease is met with among people of all ages and classes, but the majority of cases occur among young and sickly children: I shall subsequently refer more particularly to instances arising from inherited syphilis. Keratitis may, however, come on quite independently of any specific influences, and it is often difficult

to assign any positive cause for its appearance ; occasionally it is a consequence of irritation by a foreign body or wound of the cornea.

*Treatment.*—Counter-irritation in the form of an issue opened in the skin of the temple, or a succession of blisters established in this situation, are doubtless most serviceable, and hasten the reparative process in keratitis. Indeed, I know of no disease of the eye so directly benefited by counter-irritation, and it should almost invariably form a part of our treatment. *Treatment.* Counter-irritation.

It is necessary to drop a weak solution of atropine into the affected eye, so as to keep the pupil dilated ; by this means we diminish the secretion of aqueous, and preserve the iris at rest —both desirable objects in the treatment of these cases. If the eye is irritable I usually order my patients to keep it closed by means of a bandage, applied over the eyelids, to be worn during the day, but discontinued at night. No further local treatment is necessary. Atropine. Rest.

The patient's general health must be carefully attended to ; tonics, a generous dietary, fresh air, exercise, and often stimulants are demanded ; leeches and antiphlogistics I simply mention, in order that I may condemn their use in cases of keratitis. Improve the general health.

In instances arising from the presence of a foreign body in the eye, the offending substance must be removed. If, after an injury, there should be much irritation and pain in the eye, cold compresses may be kept constantly applied, and opium is often serviceable in allaying irritation. Remove irritation.

SYPHILITIC KERATITIS.—I have still to make a few remarks upon a special variety of the disease, described as inherited syphilitic keratitis. We are indebted to Mr. Hutchinson for the investigation of this affection of the eye. From a large collection of clinical material he has been enabled to show, that the majority of the cases, formerly described as "strumous" and "interstitial" corneitis, are of syphilitic origin.* The following case affords a good illustration of the origin and progress of this affection :— SYPHILITIC KERATITIS.

* *Ophthalmic Hospital Reports*, vol. i. pp. 191 and 226; and vol. ii. pp. 54 and 258.

Case.

J. N. D., aged sixteen, was brought to the Ophthalmic Hospital by his father, on the 2nd of September, suffering from syphilitic keratitis. The man informed me he had had five children, and that seventeen years ago, after the birth of his eldest son, he contracted syphilis. There seemed no reason to doubt that he then had chancre, which was followed by enlargement of the glands of the groins, and secondary symptoms. J. was born a year afterwards, and inherited the disease from which his father was suffering. I had an opportunity of examining his elder brother; he was perfectly free from any trace of the syphilitic taint; but my patient, who is the second son, and his two younger brothers, bore evidence of the existence of the disease in the state of their incisor teeth.

Primary syphilis of parent.

Keratitis in child.

J. was a well-grown and remarkably intelligent lad; he stated that, as far as he could remember, he had enjoyed uninterrupted good health up to the present time, and that the affection of the eye from which he was suffering commenced about six weeks prior to his coming to the hospital. In the first instance, he noticed that objects held before his left eye presented a hazy appearance; ultimately the sight of the right eye grew dim also, so that he is now nearly blind. During this time he suffered no pain or inconvenience beyond the gradual loss of vision.

Hazy cornea.

I found both eyes in much the same condition, the sclerotic and conjunctiva being normal, but the cornea presenting the hazy appearance of keratitis, with the characteristic zone of vessels round its margin: and, in addition to this, flocculent-looking spots, of a whiter hue than the rest of the hazy cornea, were scattered throughout its substance.

On examining this boy's teeth, the superior incisors were found to be widely separated from each other and club-shaped, their thin cutting edges being notched in the manner described by Mr. Hutchinson as pathognomonic of inherited syphilis, and plainly indicating the primary cause of the disease from which he was suffering. The following mixture was prescribed:—

*Treatment.*

| | |
|---|---|
| Hydrarg. bichlor. . . . . | gr.j. |
| Potas. iodid. . . . . | ʒj. |
| Aquæ . . . . . | ʒviij. |

Half an ounce to be taken twice a day after meals. He was also ordered to rub a drachm of mercurial and belladonna ointment over the forehead and eyebrows for twenty minutes every night; blisters were applied to the temples; and lastly, I directed him to take regular exercise, and a full and varied diet.

The medicines were used perseveringly; and on the 20th of September, the report states that the left cornea was decidedly less opaque than at the commencement of the month. The mercurial ointment was now discontinued, but the mixture was repeated. On the 15th of October his eyes were very much better, and the iodide of iron was substituted for the bichloride of mercury. A month later both cornea were perfectly transparent, no vestige of the keratitis remaining.

Recovery perfect.

In a series of instances of keratitis and iritis occurring under these circumstances, Mr. Hutchinson noticed a peculiar formation of the incisor teeth, which led him to the conclusion that their condition might be relied upon as an important test of the existence of inherited syphilis. A few delicate prominences are noticed on the edges of the central incisors: these gradually wear away after the child has used them for a time, and the free border of the tooth then becomes curved. A very common appearance of the syphilitic incisors is where some are notched and others conical or peggy. These are the permanent teeth; in the case of the temporary set, although often misshapen, irregular, and decaying, these characteristic forms are not apparent.

By syphilitic teeth.

Notched and peggy incisors.

J. N. D.'s teeth were notched and irregular, and so were his younger brothers'; but it was rather the condition of my patient's eyes which led me at once to suspect that the keratitis from which he was suffering was syphilitic. In non-specific inflammation of the cornea, it is by no means an uncommon thing to see a portion of its laminated structure remaining transparent, while other parts present a ground-glass appearance. This is also the case in syphilitic keratitis; but in this form of disease the hazy cornea is always dotted over with patches of a denser infiltration than that of the rest of the tissue, unless the case be

Characteristic patchy opacity.

near recovery, when these patches gradually disappear, and the cornea ultimately resumes its usual transparency.*

Syphilitic keratitis is almost always symmetrical, although a considerable interval may separate the onset of the disease in the two eyes. Its average duration, if brought early under treatment, does not exceed four or six months. There is no tendency either to the formation of abscess or ulceration. The majority of cases certainly recover (unless complicated with iritis or irido-choroiditis), although, if the process of cure be left to Nature, it may take a very long time before the diseased action subsides ; on the other hand, if assisted by appropriate treatment, a comparatively speedy recovery may be expected.

Ulceration rare. No tendency to ulcerate.

It is rare to meet with an instance of inherited syphilitic keratitis occurring in a child under four years of age ; opacities of the vitreous and lens from the same cause seldom make their appearance before the adult period of life. Inherited syphilitic iritis, on the other hand, generally commences when the infant is a few months old.

Age of patients.

*Treatment.* Attend to general health.

*The Treatment* of syphilitic keratitis should consist principally in attending to the patient's general health, and keeping his system in good working order, by simple, but at the same time, nourishing food, with plenty of fresh air and exercise. With regard to drugs, mercury must be judiciously used for the cure of this disease ; it may be administered most conveniently in some such mixture as that referred to above. In addition, sickly children may be ordered cod-liver oil and iron.

Mercury with discretion.

Cod-liver oil, &c.

Iodine lotion.

If there be no congestion of the vessels of the sclerotic or conjunctiva, a solution, consisting of two grains of iodide of potassium to an ounce of water, may with advantage be dropped into the eye twice a day. In almost all cases, an issue opened in the skin of the temple will prove serviceable. A fold of the integument being nipped up between the finger and thumb, a needle with a few threads of silk is passed through the skin ; the thread is then tied in a knot, and left in this way for three weeks or a month. If the patient or friends object to an issue, we

Issues very efficacious.

* *Ophthalmic Hospital Reports*, vol. i. p. 232: Mr. Hutchinson on Syphilitic Inflammation of Cornea.

must apply a series of small blisters over the skin of the temples, but they are not so efficacious as the seton. Blisters.

KERATITIS PUNCTATA is characterized by the presence of a number of small spots, scattered over the posterior elastic lamina of the cornea, consisting of patches of degenerated epithelium. This condition of the cells of the posterior elastic lamina is usually complicated with some amount of general haziness of the cornea, which, by interfering with the passage of light to the retina, renders the patient's sight very imperfect. The opaque epithelial cells are shed from time to time, and may sometimes be seen floating about in the aqueous, which becomes, in consequence, more or less turbid. By far the majority of cases of keratitis punctata occur in patients suffering from cyclitis or inflammation of its ciliary body, but we occasionally meet with instances of this form of keratitis as a primary affection of the cornea. KERATITIS PUNCTATA. Degeneration of posterior epithelium. Aqueous turbid,

*Symptoms.*—Keratitis punctata originating in the cornea causes, during the early stages of the disease, only slight pain in the eye, and dimness of vision from the opaque condition of the cornea. No pain. Dim vision.

On examining the eye we notice a zone of congested vessels surrounding the cornea, and usually there is a considerable amount of conjunctival congestion. There is generally no difficulty in detecting the presence of the opaque spots on the posterior surface of the cornea; they are, however, best seen by means of transmitted light. The aqueous appears somewhat muddy, and flakes of degenerated epithelium are occasionally seen floating about in it; some of these may be deposited on the iris, giving it a speckled appearance. But in the majority of these cases, we have, superadded to the abnormal state of the cornea, symptoms indicative of disease of the deeper structures of the eye, such as increased tension of the globe, pain in the globe of the eye, and ciliary neurosis, intolerance of light, and inability on the part of the iris to respond to its natural stimulus, or to the action of mydriatics. Congestion. Dotted opacity. Muddy aqueous. Extension to iris.

The course of this form of keratitis is unfavourable under Prognosis bad.

any circumstances; the cure is always a very protracted one, and we should be careful not to give a favourable prognosis until we are sure that the deep structures of the eye are healthy.

*Treatment.* *The Treatment* resolves itself into the use of much the same means as those recommended in cases of ordinary keratitis.

Atropine. Atropine should be applied so as to keep the pupil dilated.

Tonics. In the majority of instances, iron and quinine, and a tonic plan of treatment, will probably hasten the recovery; and in all instances of this disease counter-irritation is most valuable,

Issues. in the form of an issue in the skin over the temporal region. Should iritis or irido-choroiditis exist, as is usually the case, they must be managed according to the principles of treatment detailed in the following pages.

SUPPURATIVE KERATITIS. SUPPURATIVE KERATITIS, including abscess and ulceration of the cornea, is characterized by so great an increase in the cell infiltration or exudation into the cornea that its structure is destroyed to a greater or less extent.

1. Acute. 1. *Acute Suppurative Keratitis* is attended with considerable, often violent pain in the affected eye, extending to the eyebrow and temple. The patient complains of intolerance of

Pain and photophobia. Congestion. light and epiphora; the conjunctiva is usually much congested, and often considerable chemosis exists, concealing the injected zone of vessels which surrounds the circumference of the cornea.

Cornea suppurates. The cornea itself is hazy, and as the disease advances suppuration takes place in its laminated structure. The pus thus formed may escape externally, giving rise to an ulcer, or may burst into the aqueous chamber: lastly, it may gravitate downwards between the layers of the cornea to its inferior section, forming a yellow opaque patch, resembling in form and size the white mark seen at the root of the finger-nails, and hence the

Onyx. term onyx. The superior border of this collection of matter is convex, and being situated between the layers of the cornea, it does not change its level as an hypopion does, when the patient bends his head over to one side.

Prognosis good if pus escapes. The course which this disease pursues depends on the situation of the abscess; if superficial, the pus usually makes an opening for itself externally, and comparatively little injury is done

to the cornea ; the pressure of the aqueous from behind not only tends to force the matter outwards, but also to keep the walls of the abscess in apposition when empty, so that the cavity occupied by the pus is thus effectually closed, leaving however a more or less opaque patch in the cornea. Should it happen, however, that the haziness, though slight, is near the centre of the cornea, the patient will complain grievously of the impairment of vision which it produces.

If the abscess is situated deeply in the laminated tissue of the cornea the matter is prone to spread among the corneal fibres, and by pressure inflict irreparable damage to its structure ; or it may force its way between, and separate the posterior elastic lamina from its attachments. The chances of its finding a vent into the aqueous chamber, through the posterior elastic lamina, are small, for an opening in the latter membrane is immediately closed by the outward pressure of the aqueous. Under these circumstances the diseased action will very probably spread to the iris and deeper structures of the eye. In cases of this kind we can generally best determine the condition of the parts by the lateral method of examination ; the posterior layer of the cornea will be seen bulging backwards, and often touching the iris, and flakes of lymph and pus may usually be observed floating about in the muddy aqueous humour. The fibrous structure of the iris will be more or less hazy, and the pupil, in all probability, will refuse to dilate when atropine is applied to the eye ; or if the iris acts, the pupil may assume all manner of shapes from the existence of synechia. Under these circumstances, the pain in the eye and side of the head, from which the patient suffers, is often excruciating.

Bad if retained.

Cornea destroyed.

Danger of spreading to iris.

Signs of iritis.

Suffering great.

The prognosis, then, in this second class of cases, is unfavourable, for if the posterior elastic lamina be involved, general inflammation of the globe of the eye may at any time be excited. In other cases, the suppuration and destruction of the cornea continue until it can no longer resist the intra-ocular pressure, the degenerated structure gives way, and the contents of the eyeball escape ; or if the rent in the cornea has not been very considerable, prolapse of the iris and a staphyloma may occur.

The eye may be lost.

*Treatment.* *The Treatment* of abscess of the cornea must be conducted upon the same principle as that of a similar collection of matter in any other part of the body. If the pain and ciliary neurosis are very great, as is usually the case, warm fomentations may be constantly employed, and the subcutaneous injection of morphia beneath the skin of the temple must be resorted to. A solution of atropine should be applied to the eye every six hours.

Foment.

Morphia.

Open abscess. Whenever matter forms in the cornea, the sooner we make a dependent opening into the part the better, so as to allow the pus to escape externally. In some instances the matter is thick and cheeselike, and will not readily flow through an incision in the cornea; if this is the case, a small scoop should be introduced into the abscess, and its contents evacuated. The incision in the cornea should take an oblique direction, to avoid the risk of running the point of the instrument into the anterior chamber, which is undesirable, because the presence of the aqueous is serviceable in keeping up pressure from behind, and forcing the pus out through the external opening which we have made in the cornea.*

Avoid the anterior chamber.

Chloroform necessary. I am in the habit of administering chloroform in operations of this kind : it is otherwise frequently difficult to command the patient's eye, and open the abscess with due precision. The patient generally experiences great relief when the matter has been allowed to escape ; subsequently hot poppy-head fomentations may be used three or four times a day, and in the intervals an ointment composed of morphia, belladonna, and Indian hemp should be smeared over the eyelids, and the eye kept closed with a light pad and bandage.

Sedatives and rest.

Should it appear that the iris has become involved, the treatment of the abscess in the cornea must still be conducted upon the principles above detailed ; but we shall have to use frequent instillations of atropine, in order if possible to dilate the pupil as speedily as possible.

Atropine in iritis.

In some instances of suppurative keratitis, the tendency of the affection is to spread rapidly from the original seat of the disease, and yet the pain and irritation in the eye may have

* "Traité des Maladies des Yeux," par A. P. Demours, t. i. p. 281.

subsided. In this very dangerous class of cases a solution of sulphate of eserine should be instilled into the eye three times a day. A firm compress and bandage may be applied over the closed eyelids, but should the compress increase the pain from which the patient suffers it had better be discontinued. Eserine.

2. *Subacute Suppurative Keratitis* differs from the acute form of the disease, in that there is no marked appearance of inflammation in the part, nor does the patient usually complain of much pain or photophobia. 2. Subacute form.

It is most commonly met with among persons in a debilitated state of health; we see it for instance after cholera, starvation, or small-pox, especially among children, and it then pursues a rapid course. The disease commences with the appearance of one or more patches of exudation and suppuration, situated in the laminated tissue of the cornea: these spots extend rapidly, they coalesce, and in the course of a few days, or it may be hours, a considerable portion of the cornea is involved. In debility. Yellow corneal patches. Abscess.

The further course of the disease depends very much upon the extent and rapidity with which the degenerative changes progress, and also upon the position of the accumulated matter. If the pus has formed in the anterior layers of the cornea, the abscess may burst externally; but should it occupy the deeper layers, so as to involve the posterior elastic lamina, it is probable that the diseased action will extend to the iris and choroid. The conjunctiva is then usually much congested, and the destruction of the cornea frequently progresses rapidly. May burst externally.

*The Treatment* to be followed in these cases must be directed towards the restoration of the nutritive powers of our patients, so as, if possible, to stay the decay and death of the cornea. In all probability we shall have to resort to stimulants, a highly nutritious diet and tonics. Among the latter, the tincture of muriate of iron, given in twenty minim doses, with a grain of sulphate of quinine, every six hours, will sometimes be beneficial. *Treatment.* Support the strength.

Should a collection of matter take place in the cornea, it must be evacuated as soon as possible, in the manner already described, so as to relieve tension. These cases are occasionally influenced for good by a compress carefully applied over the eye. With regard to the compress, it is seldom likely to be Open abscess. Compress.

beneficial if it increases the pain in the eye ; we must then slacken the bandage, or leave it off for several hours during the day, and use poppy-head fomentations. Unfortunately our best efforts are too often unavailing, the destructive changes in the cornea advancing so rapidly, that we have no time to improve our patient's health. The affection, moreover, having a constitutional basis, both eyes are often involved, so that the condition of the patient is hopeless.

Keratitis from nervous lesions.

KERATITIS FROM NERVE LESIONS.—This form of keratitis arises from defective innervation of the cornea, in consequence of which its nutrition is impaired, and degenerative changes such as those above described occur. The most common cause of this form of the disease, are wounds or injuries affecting the superficial branches of the fifth nerve. Thus we occasionally see rapid destruction of the cornea take place, apparently from the irritation caused by a foreign body lodged in the folds of the conjunctiva. Injuries affecting the origin or trunk of the nerve may induce a similar train of symptoms, which when once begun generally defy our efforts to stop their progress.

Remove cause.

In cases arising from peripheral irritation of the nerve, we may, by the removal of the cause, put a stop to its injurious effects on the cornea. M. Snellen considers that in the analogous case of ulceration of the cornea, apparently arising from injury of the fifth pair, it is from the particles of dust and dirt which then find their way into the eye, that the destructive changes arise. He asserts that if, after injury of the nerve, the eyelids are kept perfectly closed, should ulceration occur at all, it is very partial in its effects.*

Protect the eye.

Sinitzin's experiments.

Dr. Sinitzin, on the other hand, considers that after injury to the fifth nerve, neuro-paralytic phenomena occur whether the eye is protected or not ; he states that, having studied the effects of ablation of the superior cervical ganglion of the sympathetic nerve upon the eye in a large number of experiments, he has arrived at the following results :—1. Immediately

Removal of cervical ganglion.

* *Annales d'Oculistique*, t. liii. p. 178; see also a case strongly confirming this view by Mr. Hulke, *Ophthalmic Hosp. Reports*, vol. v. p. 177.

after the ablation of this ganglion, increased vascular injection was constantly observable in the fundus of the eye of the same side. Ophthalmoscopic examination showed that the choroidal vessels had increased in size, that their anastomoses had become much more distinct, and that in general the fundus was of a much deeper red on the operated than upon the sound side. Hyperæmia of fundus

2. The temperature of the eye of the operated side rose. In the sac of the conjunctiva and beneath the capsule of Tenon the difference in temperature amounted to as much as 0·9° to 2·4° Cent. Increased heat.

3. The cornea of the side operated upon possessed, when compared with the other, a much greater capability of resistance to the action of foreign and neutral substances. If, for instance, a fine spiculum of glass was inserted to an equal depth into each cornea, it always happened that, whilst on the sound side the spiculum excited more or less violent conjunctivitis, pannus, purulent infiltration of the cornea, with subsequent ulceration and ultimate disintegration of the adjoining tissue, or a more or less severe iritis and threatening of panophthalmitis—on the operated side either scarcely any reaction occurred, which was most commonly the case, or at most it was but slight. It was also observable that, as Claude Bernard has shown, the stronger the animal the greater the difference in the temperature, and the sooner after the operation the foreign body is inserted the greater is the resistance exhibited by the sound side. Reaction on irritation lessened.

4. The well-known neuro-paralytic phenomena, consequent upon section of the fifth nerve in the skull, immediately in front of the Gasserian ganglion, do not occur if shortly before this operation, or immediately after it, the cervical ganglion is removed. Effects of section of 5th prevented.

5. Even when some of these neuro-paralytic phenomena have made their appearance after section of the fifth, ablation of the ganglion will cause them to vanish in the course of a few (two to four) days.

6. Such disappearance is possible so long as the surface of the cornea remains moist and polished; if these conditions have supervened, separation of the epithelium, haziness of the cornea, as well as injection and swelling of the iris, they will no longer disappear.

7. The complete atrophy or destruction of the eye, consequent upon section of the fifth, may still be staved off if the ganglion be removed during the progress of the changes, the

conditions present either remaining *in statu quo* or undergoing more or less improvement. 8. The ulceration of the lips, especially of the lower one, following section of the fifth, as well as the ulceration of the eyelids, completely vanish after section of the sympathetic. 9. For the improvement taking place under the four last heads it is not requisite for the animals to have any special protection from injury afforded. In Dr. Sinitzin's opinion, the neuro-paralytic phenomena after division of the fifth occur whether the eye of the side operated on is protected from irritation or not. 10. The diminution of temperature, observed by various experimenters on the same side after section of the fifth, never occurs when ablation of the sympathetic ganglion has been simultaneously performed. Dr. Sinitzin says that the changes in the circulation appear to be at the bottom of these effects. Ligature of the carotid, or irritation of the depressor nerve of the heart, neutralizes the inhibitory effects of the ablation of the sympathetic ganglion upon the neuro-paralytic phenomena consequent on section of the fifth.*

Protection of doubtful efficacy.

The treatment in these cases, when suppuration is established, is to be conducted upon the same principles as in the case of abscess; it may be necessary to perform an iridectomy in order to save the transparent portion of the cornea.

Iridectomy.

## ULCERATION AND ITS CONSEQUENCES.

Ulcers of Cornea

Ulceration of the Cornea may be conveniently considered under two heads, the acute and subacute, or sthenic and asthenic forms. In practice, however, we shall frequently meet with cases where it is impossible to draw a line of demarcation between acute and subacute ulceration; nor is the distinction of much importance from a practical point of view.

General considerations.

Ulceration differs from non-suppurative keratitis in that the exudation by pressure upon the tissues destroys and ultimately leads to loss of substance of the cornea. Thus it frequently happens in the case of ulceration, that the cornea is permanently injured, and sometimes its transparency entirely destroyed, either

Cause loss of substance.

* *Lancet*, 1871, p. 661, vol. i.

by the formation of a dense cicatrix, or from perforation and staphyloma. The inflammation may commence on the surface, or involving at first the deeper layers, subsequently implicate the surface of the cornea. At any stage of the process the ulcer may heal, a new formation of bloodvessels from the cornea-scleral margin takes place, and the healing process gradually occurs.

1. Acute or sthenic.

1. *Acute or Sthenic Ulceration of the Cornea* is accompanied with great pain in the eye, and intolerance of light: these symptoms are often so severe, that it is almost impossible for the patient to open his eye, and the moment he does so a gush of tears takes place, and the lids are involuntarily closed. The pain in these cases is of an intermittent character; it usually increases towards bedtime, and extends over the forehead and side of the head.

Pain severe.

Conjunctival and scleral congestion.

The palpebral and orbital portions of the conjunctiva are generally much congested, and the sclerotic zone of vessels around the cornea is deeply injected. In many instances the entire epithelial layer of the cornea is rough and hazy; but at one or more spots we notice that the cornea appears to have been destroyed. The depth, extent and situation of the ulcer will vary in almost every case.

Characters of ulcers.

The appearance also of the ulcer differs with the nature and stage of the disease; at first it looks like a greyish patch situated in the cornea; its surface is raised, its edges shading off into comparatively healthy structures, but after a time the central portion of this spot degenerates and is thrown off, an excavation in the substance of the cornea becoming apparent. The base of the ulcer may be clear and transparent, especially if the disease has eaten down to the posterior elastic lamina, which has considerable powers of resisting these destructive changes. The margins of these sthenic ulcers are generally jagged and irregular, and of a greyish-white colour.

Limited by elastic lamina.

Reparation of ulcer.

As the ulcer heals, we notice that its area lessens in circumference, the reparation beginning at the edges and extending towards the centre. As this process goes on, blood vessels will be seen coursing over the cornea and passing up to the edge of the ulcer; they gradually dwindle away as the ulcer

heals. As soon as the epithelial cells re-form the patient experiences relief from the pain and photophobia from which he previously suffered.

It would be impossible to describe the various forms which ulcers of the cornea assume, but there are some varieties so frequently met with that they require a word or two of special notice; among these the crescentic ulcer of the cornea is not only dangerous, but most difficult to treat. These crescentic or encircling ulcers commence at the edge of the cornea, and look very much as if a bit of the cornea had been chipped out. The ulcer has not only a tendency to extend itself round the circumference of the cornea, but also to eat deeply into its substance. The supply of nutritive material is necessarily cut off from the central part of the cornea, and it may consequently slough. These cases of ulceration, though similar in their results to those occurring in purulent conjunctivitis, may arise quite independently of inflammation of the conjunctiva.

Encircling ulcer.

In other cases, the ulcer assumes a funnel-shape, extending deeply into the cornea, and is very apt to perforate it in spite of our best efforts.

Perforating.

2. *Subacute, or Asthenic Ulceration of the Cornea* is not characterized by pain, photophobia, or any of the more urgent symptoms of irritation noticed in the acute form of the disease; there is seldom much congestion of the sclerotic or conjunctival vessels, and the ulceration is often a tedious process, but, fortunately, has less tendency to involve the deeper layers of the cornea, and consequently to lead to a staphyloma, than the more acute forms of the disease.

2. Subacute ulcers.

These asthenic ulcers are generally superficial; their borders are well-defined and sharp, as though a piece had been punched out of the cornea. Few, if any, vessels will be seen running up to them from the conjunctiva; in fact, there is evidence of want of action in the part, the ulcer neither spreading nor healing, except by slow steps.

Superficial and sharp.

Inactive.

*Prognosis.*—This will depend more upon the depth and situation of the ulcer than upon its being either of a sthenic or asthenic character. Thus, even a subacute ulcer, from its long continuance, may involve the posterior elastic lamina, and ulti-

Prognosis, varies with depth and seat.

mately set up lesions in the deeper structures of the eye ; though such complications are doubtless more liable to occur in cases of sthenic ulceration, because the latter has a marked tendency to spread, not only in circumference, but also to the deeper layers of the cornea.

Again, the course of sthenic ulcers being more active, when once they begin to heal, reparation goes on favourably ; but whenever there has been loss of substance in the cornea, whether by acute or subacute ulceration, more or less opacity of the part will remain; and should this opacity happen to be situated in the axis of vision, the patient's sight must be impaired. Much may perhaps be done by forming an artificial pupil, but still the injury inflicted by the ulcer is lasting.

Risk of cicatrices, central opacity,

Unfortunately, this does not represent the whole risk of corneal ulceration : we have not only to fear the formation of cicatricial tissue in deep ulcers of the cornea, but also that the attenuated cornea at the seat of ulceration may give way before the intra-ocular pressure, and that a staphyloma of the cornea and iris will occur.

and staphyloma.

The situation and depth, therefore, of the ulcer are important points to consider in forming a prognosis : superficial ulcers may heal, and the parts recover their normal transparency, but the effects of deep ulcers of the cornea are never overcome. Should the latter not extend to the centre of the cornea, they may still be comparatively harmless; but if, from thinning of the cornea, a staphyloma takes place, this, by involving the iris, as I shall subsequently explain, is apt to occasion serious mischief, if not absolutely to destroy the eye.

Effects of deep ulcers indelible.

*Treatment.*—It will be evident from what I have just said regarding the prognosis, that our main object in treatment must be to prevent, if possible, the ulcerative process from extending either in depth or area ; for such extension must result in loss of transparency in the cornea.

*Treatment.*

In most instances of ulceration (excepting traumatic cases, or those depending on conjunctivitis), the patient's general health will be found at fault ;* in no affection of the eye is it more

Improve nutrition.

* "Lectures on Diseases of the Eye," by J. Morgan, 2nd edit., p. 111.

necessary to attack the disease by improving the assimilative and nutritive functions of the body, and as a general rule, a tonic and supporting plan of treatment is demanded. Iron and quinine, good food, cleanliness, and fresh air are the fundamental requisites for the cure of almost all instances of ulceration of the cornea, whether they be of the sthenic or asthenic type. One frequently sees cases of ulceration of the cornea which resist all treatment, but which rapidly improve if the patient is sent to the sea-side, or still better, for a voyage to sea.

Tonics, food, and air.

Opium is an invaluable remedy in cases accompanied with considerable pain and irritation of the eye—in fact, in what would usually be considered acute cases. For an adult, I generally prescribe about a grain of opium twice a day, sometimes in combination with soda and quinine. At the same time, a strong solution of atropine should be dropped into the eye three times a day; and the extract of belladonna having been smeared over the temple and eyebrow of the affected eye, the eyelids must be kept closed with a light pad and bandage. It sometimes happens that a solution of sulphate of eserine instilled into the eye in place of atropine is of great service in cases of spreading ulcers of the cornea, especially in encircling ulceration such as that above referred to.

Opium.

Atropine.

Pad and bandage,

The aim of all this is to insure the diseased cornea rest; the opium allays the nervous and vascular irritation, and enables the patient to sleep; the atropine retracts the iris, thereby diminishing its secreting surface, and the quantity of aqueous which is formed, and this, by lessening the intra-ocular pressure relieves the tension of the cornea. Lastly, the eyelids are kept closed, to exclude the stimulus of light and prevent the lids rubbing against the ulcerated cornea.

to insure rest.

In instances of sthenic ulceration the dilute caustic pencil may sometimes with advantage be lightly passed over the surface of rapidly-spreading ulcers of the cornea; in the majority of instances, however, more harm than good is done with nitrate of silver, and as a general rule I would not advise its employment in these cases. In fact, all lotions or applications to the eye should be avoided in ulceration of the cornea, except the solution of atropine, or of eserine; this is the more necessary if we

Caustic.

notice vessels passing from the circumference of the cornea to the border of the ulcer.

Issues.

In most cases of ulceration of the cornea an issue should be opened as soon as possible in the skin over the temporal region near the affected eye. In spreading ulcers of the cornea, if other means fail, iridectomy should be performed, the iris being removed from behind the most transparent part of the cornea so that we shall subsequently have the advantage of an artificial pupil in this situation.

Iridectomy in rapid ulcers.

If less urgent, draw off aqueous.

Supposing, however, that the ulcer is not advancing rapidly, and the symptoms do not appear to be sufficiently urgent to demand so grave an operation as iridectomy, we may possibly avert the formation of a staphyloma by opening the anterior chamber with a broad needle, and allowing the aqueous humour to escape. In this way we can relieve the tension of the cornea, and diminish the chances of the aqueous bursting through its attenuated structure at the point of ulceration.

Paracentesis of cornea.

Directions.

In performing paracentesis of the cornea under these circumstances, the point of the needle should just be allowed to pass through the floor of the ulcer into the anterior chamber, otherwise the iris, or even the lens, may be wounded. It is by no means necessary to wait until the deeper layers of the cornea are involved before performing paracentesis, for we thus limit the opening in the cornea to that of the size of the needle we introduce, in place of having a large rent through the bottom of the ulcer. The puncture should be made with a needle, so that the aqueous may escape slowly. Under these circumstances the iris gradually moves forward as the aqueous escapes, and comes to rest against the opening in the cornea, very likely adhering to it by neoplastic formations; but these give way as the cornea closes, the aqueous thrusting back the iris and lens into their normal position. If, after puncturing the ulcer we notice, in the course of a few days, that its base is again bulging forwards and likely to burst, we must again perform a paracentesis, and we may have to repeat the operation more than twice. After each occasion on which the cornea is opened, the eyelids and temples should be smeared over with the extract of belladonna, or the atropine ointment,

and the eye kept carefully closed with a light compress and bandage.

Asthenic ulcers.

If the ulcerative process be asthenic, want of action characterizing the disease, and few if any vessels passing from the conjunctiva to the ulcer, we may stimulate the part by hot compresses applied over the lids, for an hour, once or twice a day; or calomel, dusted over the ulcer from time to time, will be useful.

Hot compresses. Calomel.

But if vessels have formed over the cornea, and are extending up to the border of the ulcer, we should discontinue all treatment, simply keeping the pupil dilated, and the eye closed with a compress and bandage. The process of cure will usually be expedited by change of air, well-regulated diet, and other means tending to improve the patient's general health.

Hygienic measures.

In cases of ulceration of the cornea complicated with perforation, I would refer the reader to the section on prolapse of the iris.

HERNIA OF CORNEA.

HERNIA OF THE CORNEA consists in a protrusion of the posterior elastic lamina through the outer layers of the cornea, which may have been destroyed by ulceration. The elastic lamina has considerable power in resisting destructive changes, and hence, after the laminated tissue of the cornea has been destroyed, it may remain unaffected, and being forced outwards by the pressure of the aqueous, form a little glassy-looking nodule, projecting from the corneal surface. The transparent appearance of the tumour, bulging through the jagged border of the ulcer, is sufficiently characteristic to enable us at once to recognize the nature of the disease.

Elastic lamina protrudes,

as a glassy nodule.

From the extreme thinness of the posterior elastic lamina, it necessarily follows that, when a hernia of this kind has occurred, the slightest force applied to the eye is likely to rupture it. Hence herniæ of the cornea are of short duration, and seldom come under observation, the posterior elastic lamina usually giving way before the distending force of the aqueous, the corneal hernia being replaced by a prolapse of the iris. It occasionally happens, however, that the hernia remains for some

Often bursts.

weeks, and then gradually becomes converted into cicatricial tissue.

*Treatment.*—The patient having been placed under the influence of chloroform, and a stop speculum adjusted, a broad needle should be run through the cornea, and the instrument being tilted on its edge, the aqueous is allowed to escape slowly from the eye. The needle is then to be removed, and a solution of atropine dropped into the eye, a compress and bandage being firmly applied over the closed lids, and kept there for forty-eight hours. The eye may then be examined but it will be better to re-apply the compress, and continue its use for some days.

*Treatment.* Draw off aqueous. Apply a compress and bandage.

It may be, that on opening the lids at the expiration of forty-eight hours, we find the hernia of the cornea reproduced, in which case the paracentesis must be repeated, the compressing band and the caustic pencil being applied. This treatment will excite sufficient inflammation in the part to set up material changes in the ulcer, and although a cicatrix will remain as a permanent blemish, still, its formation may prevent a prolapse of the iris with its attendant evils.

Repeat if needful.

STAPHYLOMA OF THE CORNEA AND IRIS.—If the resisting power of the fibrous structure of the cornea has been destroyed, or considerably weakened by the ulcerative process, the remains of the laminated tissue, together with the posterior elastic lamina, are very likely to yield to the distending force of the aqueous; and bulging forwards, to a greater or less extent, they form a staphyloma of the cornea.

STAPHYLOMA OF CORNEA. Weakened cornea bulges.

From their relative positions, it follows, that when a partial protrusion of the cornea occurs, the iris is apt to be carried forward into the protrusion. Moreover, in the majority of these cases, a small opening occurs at the most prominent part of the staphyloma, through which the aqueous drains away; or the aqueous may percolate through the attenuated portion of the cornea; in either case, the anterior chamber being emptied, the vitreous forces the lens, and with it the iris, forwards against the cornea. The iris thus frequently becomes glued down to the inner surface of the protrusion (*vide* Fig. 35), while its outer

The iris follows.

False coating formed.

surface acquires a coating of fibrous (cicatricial) tissue, and thus the staphyloma ultimately assumes a dense opaque appearance.

FIG. 35.

Staphylomata of this kind vary much in size, sometimes being so large that they protrude between the eyelids, at other times they are no larger than a pin's head. The thickness of their walls is also subject to variation : in many instances the summit of the staphyloma is very thin, whereas in other cases it is comparatively thick, and may contain cholesterine imbedded in it.

Perforation or rupture.

The apex of the staphyloma, as I have before remarked, may ulcerate, and a fistula form, through which the aqueous drains away : or the staphyloma may burst open, and through the rent thus made, the lens, and, in fact, the contents of the globe, escape ; the eyeball then shrinks up, and sinks into the orbital socket.

Composite forms.

It sometimes happens that more than one staphyloma exists in the same cornea. This condition arises from the previous formation of several ulcers in the cornea, which has accordingly yielded at more than one spot to the intra-ocular pressure, while the intermediate parts, retaining their fibrous structure, have effectually resisted the distending force, forming bands between which the several small staphylomata have occurred.

Effect on vision.

The symptoms to which a staphyloma of the cornea give rise consist principally in various degrees of impairment of vision, depending upon its position and size. When endeavouring to estimate what may be the ultimate effect of a staphyloma on the patient's vision, the condition of the iris is one of the first points for consideration, in instances where a portion only of the cornea is involved. Should the iris have been drawn into the protrusion, it is very probable that the pupil may likewise be included in the staphyloma, and the patient will not be likely to see much with an eye so affected. In other cases a part of the pupil may remain free, and should there be any transparent cornea in front of it, the patient may still retain a fair amount of sight. Again, supposing the staphyloma leaves the centre of the cornea clear, it is far less likely to impair the

If pupil included, little sight will remain.

sight than if situated in the axis of vision. It is by no means an uncommon circumstance, however, for glaucomatous changes to occur in an eye in which a staphyloma has become developed; the degree of tension of the eyeball must therefore be carefully attended to in cases of this kind.

*Treatment.*—This will depend on the size of the staphyloma and the length of time it has existed. *Treatment.*

1. If the protrusion be a small one, and of recent formation, the best thing we can do is to puncture the inferior part of the staphyloma with a broad needle, so as to allow the aqueous to escape, and then apply a firm compress and bandage over the eye; the instillation of atropine should also be employed. Our first object in this proceeding will be to empty the anterior chamber; the intra-ocular pressure being thus removed, the compress may possibly prevent a re-formation of the staphyloma, until cicatricial tissue has formed, which retains the parts in their normal position. 1. If small, let aqueous escape. Apply compress and atropine.

2. If the staphyloma is a large one—involving, say, a quarter or more of the cornea, we must resort to an iridectomy, as the surest means of treatment. If this be neglected, it is very probable that the iris and pupil will subsequently be drawn into and become attached to the cornea; we anticipate this evil, by excising at once a fourth of the iris from behind the clearest portion of the cornea, we release the iris from its attachment, and by diminishing its secreting surface lessen the quantity of aqueous formed, so that we may hope, by the careful application of a compress and bandage subsequently to the iridectomy, to reduce the dimensions of the staphyloma itself; and beyond this, prevent glaucomatous changes from taking place in the eye. 2. If large, excise iris. Aqueous lessened.

Besides the immediate advantages to be derived from this proceeding, we must bear in mind the fact, that if the iris becomes permanently involved in a staphyloma, it may give rise to sympathetic irritation in the other eye; this is therefore an additional reason for resorting as early as possible to iridectomy in this class of cases.

3. In instances of large and old staphylomata, in which a portion of the cornea remains transparent, a similar plan of 3. If old and large, apply atropine.

treatment must be adopted. In the first place, it will be necessary to apply atropine to the eye, in order that we may discover the state of the pupil, whether it remains partially open, or has been entirely occluded and dragged into the staphyloma.

Iridesis, if pupil free.

In the former case, it will dilate under the influence of atropine, and, if practicable, we must form an artificial pupil.

On the other hand, supposing the pupil has been dragged into the staphyloma, it follows that the communication between the anterior and posterior chambers of the eye will have been closed, and the canal of Schlemm and the surrounding lymphatics obliterated. Hence, fluid collecting in the posterior chamber cannot escape, and must cause abnormal pressure upon the retina and deeper structures of the eye, which unless relieved will certainly terminate in total loss of vision. Under these circumstances we should perform an iridectomy, so as to prevent the angle of the iris being dragged forwards, destroying the lymphatic spaces of Fontana.

Iridectomy, if pupil closed.

4. Abscise a complete staphyloma.

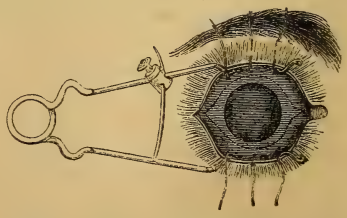
4. In instances of staphylomata involving the whole of the cornea (Fig. 36), and being an inconvenience to the patient, not only on account of their unsightly appearance, but also by interfering with the action of the eyelids, either the following procedure or excision of the eyeball should be performed.

Operation of abscission.

The patient having been placed under the influence of chloroform, a stop speculum is adjusted, and the surgeon transfixes the globe of the eye with a couple of needles armed with a stout silk suture, in a line corresponding to the ciliary processes (Fig. 37). The staphyloma is then to be secured with a pair of toothed

FIG. 36.

FIG. 37.



forceps, and that part of the globe of the eye anterior to the suture is to be removed with a knife or a pair of scissors. The

ends of the suture are then to be tied, so as to bring the edges of the wound in the sclerotic together, the speculum removed, and water-dressing applied to the eye. As a rule, however, it is better to remove the staphylomatous eye entirely, rather than to abscise the front of it.

FISTULA OF THE CORNEA is an occasional sequence of ulceration; the opening through the cornea usually takes an oblique direction, and is prevented from healing by the constant drain of aqueous through it. FISTULÆ OF CORNEA.

No sooner does perforation of the cornea take place, than the iris and lens are thrust forward, and should the capsule come in contact with the internal opening in the cornea, it is likely to give rise to partial capsular cataract. But more serious consequences may be expected to follow if the fistula remains open; for the constant dribbling away of the aqueous diminishes the intra-ocular pressure, and gives rise to anomalies in the circulation through the choroid and retina, terminating, probably, in extensive disease of the fundus of the eye. Anterior synechia, again, may form in instances of fistula, from the contact of the iris with the cornea; and when this has taken place, irritation of the iris is apt to be induced, and extending to the choroid may compromise the eye, and involve the sound one in sympathetic irritation. May cause capsular cataract, and other intra-ocular changes.

A fistula of the cornea may arise from other causes than ulceration, as for instance a penetrating wound which has been prevented from entirely closing by the drain of aqueous through it. But from whatever cause produced, the fistula may at any time lead to complications such as those I have mentioned above. Causes.

We can seldom overlook the existence of a fistula of the cornea; its external orifice may generally be seen, a minute drop of aqueous oozing through it when gentle pressure is made on the globe of the eye. The depth of the anterior chamber is much diminished, and in many instances the iris is thrust forwards against the posterior surface of the cornea.* Appearance.

* "Traité des Maladies des Yeux," par A. P. Demours, t. i. p. 308.

*Treatment.* *Treatment.*—Fistulous openings in the cornea are difficult to heal, on account of the drain of aqueous through them; the lens, moreover, being thrust against the internal orifice of the cornea, keeps up irritation in the part, tending yet further to interfere with the healing of the fistula.

Crucial incision in cornea, In cases of this kind, the best plan of treatment is to administer chloroform, and having separated the lids with a spring speculum, to pass a blunt-pointed needle, with a cutting edge, through the fistula, and incise the whole thickness of the cornea from above downwards, and from side to side. The edges of a crucial incision of this kind will fall into accurate apposition; and if a compress and bandage be carefully applied, it is more than probable they will heal in the course of forty-eight hours and the fistula be cured.

and compress.

Compress and bandages. Atropine. Before resorting to this treatment, we may be inclined to try what a simple compress and bandage, applied over the closed lids, will do, a solution of atropine at the same time being dropped into the eye twice a day, in order, if possible, to dilate the pupil. In addition to this, the external orifice of the fistula may be touched with a pencil of dilute caustic every two or three days; but I would not advise much time to be expended on this kind of treatment; it seldom succeeds, and it is probably better, in most instances, to divide the fistula as soon as possible by a crucial incision.

Dilute caustic pencil.

Opacities of Cornea. Opacities of the Cornea.—Opacities of the cornea vary greatly in extent and density, as well as in their permanency, according to the circumstances which have given rise to them.

Varieties. The opaque condition may amount only to a milky cloudiness, extending over the whole cornea, or it may be confined to certain portions of it; and may be limited to the superficial layers, or occupy the substance of the proper corneal tissue. In other cases, following considerable loss of substance in the cornea, the opacity is much denser. The denser variety of opacity is described as *leucoma*; hazy, semi-opaque forms are called *nebulæ*.

Leucoma and nebulæ.

Limits of restoration. Epithelial and interstitial opacities, depending on the presence of cellular infiltration, may in time clear away more or less

completely, and we shall have the better reason to expect such a result the more recent the affection, and the younger and more vigorous the patient. On the other hand, whenever there has been loss of corneal substance, which has been replaced by cicatricial tissue, restoration of transparency is impossible. Such new formations, however, are often surrounded by a margin of cloudy opacity, which may clear away spontaneously.

Cicatrices never transparent.

*Prognosis.*—The chief points for consideration, in forming a prognosis in instances of opacity of the cornea, are the situation and extent of the structural changes that have taken place. For the reasons already stated, a dense leucoma can never be removed, and if it be situated in the axis of vision, our main hope will rest in forming an artificial pupil should any part of the cornea remain transparent. If the leucoma, on the other hand, is eccentric, and the pupil in its normal position, the opacity will be of comparatively little consequence. It generally happens, however, that the border of a leucoma shades off into a nebulous area, and if this extends in front of the pupil, it may be almost as detrimental to the perfection of vision while it lasts as a denser opacity would be.

*Prognosis.*

Artificial pupil the only remedy in leucoma.

In the case of nebulæ, where the cause which gave rise to them is no longer in operation, and the patient young, we may look for a disappearance or great diminution in the opacity; but this must be a work of time. Some varieties of nebulæ, more especially those which are the result of syphilitic keratitis, are apt to shift from one part of the cornea to another, and a change of position, with regard to the axis of vision, may greatly modify their effect on the sight. If situated in the laminated tissue, or in the posterior layer of the cornea, nebulæ may be easily overlooked, unless the part is carefully examined by the lateral method of illumination. We cannot, therefore, be too careful in exploring these parts, when dimness of vision is complained of; for opacities, though so faint that they are with difficulty detected, may be sufficient to obstruct the passage of rays of light, and so offer serious embarrassment to distinct vision.

Nebulæ may clear off or shift.

Nebulæ easily overlooked.

Yet greatly hinder vision.

Slight opacities of the cornea, if of long duration, may induce myopia. The haziness of the transparent media, by

May cause myopia,

diminishing the clearness of the visual image, causes the patient constantly to exert his accommodative power in the vain effort to attain distinct vision, and this ultimately leads to hypertrophy of the contractile tissue which determines the curvature of the lens; its anterior surface thus remains abnormally convex, and the result is a permanent myopia, although the opacity of the cornea may subsequently clear away.

or strabismus.

Strabismus, again, is occasionally a result of central opacities of the cornea, the strain of accommodation, and associated increased action of the internal rectus muscle, inducing strabismus of the weaker eye. This tendency is augmented by the necessity that exists of excluding from binocular vision the eye which is clouded, in order to maintain the most distinct impressions when fixing an object. Should the opacity continue for any length of time, the sensibility of the retina may be destroyed, and the eye rendered useless for optical purposes.

*Causes.*

*The Causes* which give rise to opacities of the cornea are

Glaucoma.

numerous. Glaucoma, for instance, may render it hazy, the changes which occur in the choroid affecting the long ciliary nerves, and hence impairing the innervation and nutrition

Iritis.

of the cornea. In certain forms of iritis, the posterior layers of the cornea are often involved, and this may give rise to

Keratitis.

opacities. Keratitis punctata and the various forms of inflammation and ulceration of the cornea are frequent causes of leucoma or nebulæ.

Chemical agents.

Chemical agents again, by destroying the vitality of the tissue, may induce opacity of the cornea. Acetate of lead, applied as a lotion to the eyes, by chemical decomposition with the lachrymal secretion, may be converted into carbonate of lead and become deposited on the cornea in the form of a permanent opacity, especially if its surface happens to be ulcerated or uneven at the time the lotion is used. In like manner, nitrate

Illustration.

of silver, if long used as a lotion to the eyes, may stain the cornea and conjunctiva black. Opacities of the cornea, again, may be induced by the deposit of earthy matter on its surface.

Wounds and injuries.

Wounds and injuries, which cause loss of substance, must, in healing, give rise to leucoma, while slight mechanical violence may be followed by only temporary opacity. But of all these

causes of loss of transparency, ulceration and mechanical irritation from disease of the palpebral conjunctiva are by far the most frequent.

*Treatment.*—In cases of leucoma, as I have already remarked, it is impossible, by any remedial agencies, to remove the opacity. We may often do much towards restoring the patient's sight by means of an artificial pupil, but so far as the cornea is concerned, it is useless to attempt improvement. If the leucoma is of recent formation, it is possible that the hazy rim of cornea which usually surrounds it will gradually disappear, and thus the extent of opacity diminish.

*Treatment.*

Artificial pupil in leucoma.

In cases of nebulæ, time will often effect a cure, especially among young people; but we may sometimes hasten the process by the application of a lotion containing one grain of iodine, and two of iodide of potassium, in an ounce of water, a few drops to be instilled into the eye twice a day. Should this lotion cause any irritation, it must be discontinued for a time.

Nebulæ often get well.

Iodine drops.

If the opacity is superficial, the cornea should be dusted over with calomel every other morning. The dilute red oxide of mercury ointment, weak astringent lotions, and in fact a multitude of so-called specifics, have been employed from time to time to cure these opacities of the cornea. If there is any irritation about the eye, the extract of belladonna may be smeared over the lids, and a light pad and bandage applied, so as to keep it at rest.

Calomel.

Ung. hyd. ox. rub.

Belladonna.

Opacities of the cornea arising from stains, such as that caused by nitrate of silver, can hardly be removed; a weak solution of cyanide of potassium has been recommended and may be tried for want of any more efficient plan of treatment. The opacities produced by deposits of carbonate of lead are more manageable. The patient must be placed under the influence of chloroform, and a stop speculum having been applied, so as to separate the lids, the eye is to be fixed with a pair of forceps, and the surgeon may then scrape off the deposit of carbonate of lead from the laminated tissue of the cornea with a broad needle. A few drops of oil should be dropped into the eye after the deposit has been removed, and the lids kept closed with a pad and bandage for a few days. The

Pot. cyan. for silver stains.

Lead deposits scraped off.

Calcareous opacity.

same treatment may be adopted in cases of a deposit of earthy matter formed on the surface of the cornea. The opacity has the appearance of occupying a superficial position, and of being very slightly raised, but the surface reflects the light as brilliantly as other parts of the cornea. These opacities come on gradually, and are caused by a deposit of the salts of lime beneath the epithelium of the anterior layer of the cornea.

Tattooing cornea.

It has been proposed to tattoo opaque spots in the cornea; and there can be no question as to the fact that this proceeding not only improves the appearance of the affected eye, but also diminishes the diffusion of light thrown on the retina in instances of opacity of the cornea; but it is apt to set up dangerous irritation in the eye. The operation of tattooing the cornea is performed as follows :—The lids having been separated with a speculum and the globe of the eye fixed, a number of small oblique punctures are made into the cornea with a sharp-pointed hollow spud, or needle, which has been dipped in fluid Indian ink. The speculum should be left in the eye till the ink has dried in the cornea. The operation may have to be repeated several times until the requisite amount of the white spot in the cornea has been dyed black.

Vascular Opacity of Cornea.

PANNUS, OR VASCULAR OPACITY OF THE CORNEA.—Although pannus may be the result of keratitis, the distinction between these two affections of the cornea is obvious, for in pannus the cornea is usually uniformly opaque, as though covered with an adventitious coating, and the vessels branching over it are large, tortuous, and distinct from one another, the sclerotic and conjunctiva being only slightly congested. In

Contrasted with keratitis.

keratitis, on the other hand, the opacity of the cornea is partial, and of a ground-glass appearance, obviously from changes in the corneal tissue itself; the cornea is surrounded, to a greater or less extent, by a zone of very minute vessels, which advance only a slight distance over the margin of the cornea. The sclerotic zone of vessels is also well marked in the active stage of the disease, and the conjunctiva is more or less congested.

Sometimes follows it.

In some few cases of keratitis, large tortuous vessels extend themselves over the cornea from the conjunctiva; the patient

complains of considerable pain in the eye, and ciliary neurosis, and the cornea is uniformly hazy. As the disease becomes chronic, the pain subsides, and the congestion of the sclerotic and conjunctiva disappears, but the cornea remains opaque and vascular—in fact, pannus may then be said to exist.

May arise from ulceration;

Ulceration of the cornea may give rise to pannus; in almost all instances of healing ulcers, a vascular band can be traced from one or more points of the circumference of the cornea, extending towards the ulcer; and if the parts remain in a state of chronic irritation for some time, the vascularity of the cornea may continue, especially if that portion of it formerly occupied by the ulcer remains uneven, and therefore a source of irritation.

more often from granular lids.

But inflammation and ulceration of the corneal tissue are by no means the most frequent causes of pannus; vascular opacity of the cornea more often arises from the effects of chronic granular conjunctivitis, the palpebral surface of the conjunctiva having been rendered uneven from the cicatricial tissue which has formed, and being a source of constant irritation as it traverses the cornea in the movements of the eyelids. Under these circumstances, the superficial layers of the cornea often become opaque, and large tortuous vessels gradually extend themselves over its surface. The thickness of this vascular layer will of course vary in different cases; in some instances it is so dense that even the outline of the cornea cannot be distinguished from the sclerotic, while in others, the iris and pupil may be dimly visible through the semi-opaque and vascular cornea.

Density of vascular layer.

Other causes.

Pannus sometimes occurs from the irritation caused by inverted eyelashes, the result of either trichiasis or entropium.

*Treatment.*

*The Treatment* of vascular opacity of the cornea will depend upon the cause of the disease; for instance, if arising from trichiasis, or entropium, the inverted cilia or margin of the lids must be either removed, or restored to their normal position, before we can hope to overcome the disease; and if we can only succeed in getting rid of the source of irritation, we shall have every reason to expect that the condition of the cornea will improve.

Remove the cause.

If lids contracted,

In many instances of pannus, consequent on granular or

diphtheritic conjunctivitis, the contraction of the cicatricial tissue following these affections shortens the lids from side to side, so that they press unduly and irregularly against the eyeball; this, together with the roughness of their surfaces, irritates the cornea during the movements of the eyelids. Under these circumstances we must endeavour, in the first place, to correct this shortening of the eyelids, and for this purpose it will be necessary to divide the external commissure as described at p. 106. By this proceeding we not only elongate the palpebral fissure, and directly relieve the pressure exerted by the contracted eyelid on the cornea, but having divided some of the fibres of the orbicularis muscle, we weaken its action, and this again tends to lessen the pressure of the lids on the eye. Provided we can, by this proceeding, sufficiently relieve the friction of the palpebral conjunctiva against the diseased cornea, the pannus will probably disappear to a great extent without further treatment; this desirable result is, however, frequently hastened if tannic acid be dusted over the cornea every morning, until the opacity diminishes, when it may be be used every three or four days.

elongate palpebral fissure.

Supposing, however, that no favourable results follow this treatment, or that the condition is due to some other cause than contraction of the eyelids, we may still hope to improve the state of the cornea, by inducing purulent inflammation in the diseased eye. The more vascular the cornea, the less danger is there of the suppurative inflammation being followed by destructive ulceration.

Excite purulent inflammation.

The state of the patient's general health should be attended to before submitting him to this plan of treatment, for if he happens to be in a weak condition, sloughing of the cornea is more apt to occur.

Precaution as to health.

There is seldom any difficulty in exciting purulent inflammation in the diseased eye; but in some few instances the conjunctiva has been so completely altered in character, after long-continued granular conjunctivitis, that I have been obliged to inoculate it with pus several times before I could succeed in establishing purulent inflammation.

Inoculation.

The pus employed for inoculation may be taken from the eye

of another person suffering from purulent conjunctivitis, or gonorrhœal matter may be used. It should be placed on the everted lower lid, and a few slight punctures in the conjunctiva be made with the point of the lancet, so as to insure the grafting of the matter. In the course of thirty-six hours the purulent matter grows rapidly, causing first irritation and inflammation, followed by purulent discharge.

Let inflammation run its course.

So long as the cornea remains free from ulceration we may allow the inflammatory process to run its course, simply keeping the eye scrupulously clean. If ulceration of the cornea supervenes during the progress of the disease, we must strictly follow out the treatment recommended in cases of purulent conjunctivitis. It is interesting to watch the effects of the inflammatory process on old-standing vascular opacities of the cornea; they often improve remarkably as the suppurative action subsides, and ultimately the patient may regain some amount of vision.

Chlorine lotion.

After the inflammation has entirely passed away, chlorine water may with advantage be dropped into the eye three or four times a day: it appears to act as a mild stimulant, and is certainly a useful remedy in cases of this kind.

PERITOMY.

In cases of pannus.

PERITOMY.—This operation consists in excising a band of conjunctiva and subconjunctival tissue about the eighth of an inch broad, extending entirely round the circumference of the cornea and close up to its margin, so as to cut off the communication between the vessels of the conjunctiva and those covering the cornea.

The patient being under the influence of ether, the lids are to be widely separated with a spring speculum, a fold of conjunctiva is to be seized with a pair of toothed forceps, and with a pair of curved scissors an incision is carried through the conjunctiva round the cornea. The band of conjunctiva is now to be dissected off, together with the subconjunctival tissue down to the sclerotic. The lids are then to be closed and covered with a compress and bandage. I agree with Mr. G. Lawson that this operation is well suited for severe cases of pannus which continue *after* the granulations of the lids has been cured; but my experience of it has not been very encouraging.

Conical Cornea.

A transparent bulging.

Conical Cornea consists in a thinning and bulging outwards of the whole or a part of the cornea, without loss of transparency. It sometimes appears as an abrupt cone rising from the centre of the cornea, or the protuberance may be eccentric, but, as a general rule, the whole of the cornea is involved, its centre forming the most prominent part of the cone (Fig. 38). It necessarily follows, under these circumstances, that the refraction of the rays of light entering the eye is greatly increased, and they are brought to a focus anterior to the retina; the patient is therefore myopic. As a general rule, the disease appears between the ages of fifteen and twenty-five. It does not occur as a sequence of inflammation, but more commonly manifests itself in weak and sickly subjects, and generally progresses with equal rapidity in both eyes, though it may advance more rapidly in one than the other.*

Fig. 38.

Causes myopia.

Cornea seldom gives way.

In conical cornea, although the protuberance is often considerable, the cornea seldom gives way; it seems probable that as the laminated tissue becomes thinner it allows of a freer transudation of aqueous fluid through its substance than in health, and the intra-ocular pressure being thus relieved, there is not the same tendency that there otherwise would be, for the attenuated tissue to rupture, and give exit to the contents of the eyeball. There can be no doubt of the fact, that as the first step in this change, the laminated tissue of the cornea yields to the intra-ocular pressure, apparently from an inherent weakness in its fibrous structure; but that when the consequent attenuation has reached a certain limit, the balance is restored by exosmosis, and further distension prevented. These alterations in the resisting powers of the fibrous layers of the cornea advance most rapidly in its central portion, and degenerative changes occasionally occur in this situation, which render it

Due to primary weakness of tissue.

* *Ophthalmic Hospital Reports*, vol. ii. p. 157, 1859.

more or less opaque ; but with this exception, notwithstanding the very remarkable alteration of form which the cornea undergoes, it remains transparent.

The rapidity with which the disease progresses is variable ; sometimes it makes rapid strides, and in other instances takes years to advance. These variations, however, will much depend on the state of the patient's health ; any cause which impairs the nutrition of the part, or which induces congestion of the choroid, and increased intra-ocular tension, will tend to augment the protrusion. Excluding such disturbing causes, the disease will generally advance to a certain point, and then remain stationary for years, or it may be for life.

Progress depends on state of nutrition.

*Symptoms.*—Besides the alteration in the appearance of the eye, conical cornea gives rise to impairment of vision, the degree of which depends very much upon the extent to which its curvature has been altered. In the early stages of the disease, the patient probably complains of slight, but gradual increasing, myopia, consequent on the increased refractive power of the dioptric media. This defect may be corrected for a time by the use of concave glasses; but as the disease advances, not only is the refraction so much augmented that concave glasses cease to rectify the evil, but even before the disease has reached this stage, the altered curvature of the cornea, which is seldom equal in all its planes, gives rise to astigmatism. This again, if stationary, may be overcome by the use of cylindrical glasses. Should the degenerative changes continue to progress, opacity of the central portion of the cornea gradually supervenes, and the eye is destroyed.

*Symptoms.*

Myopia.

Astigmatism.

It is seldom possible, by light directly thrown on the part, to appreciate the slight increase in the convexity of the cornea that marks the early stages of the disease ; it is necessary to employ the lateral method of examination ; the bulging forwards of the central portion of the cornea will then become distinctly visible in most instances. Should any doubt on the subject still exist, the ophthalmoscope without a convex lens in front of it may be used, the light from the instrument being thrown from a distance of about twenty inches at different angles on the cornea ; the side of the cone opposite the light will then appear

Examine by lateral illumination,

or ophthalmoscope.

darkened, or cast into the shade. This test is a very delicate one, and may be relied on when simple inspection fails to satisfy us.

*Treatment.* *Treatment.*—Our first and obvious duty will be to supply the patient with concave or cylindrical glasses, to correct his error of refraction, and thus prevent, as far as possible, all straining of the eyes, which tends to produce intra-ocular congestion and increased tension of the globe. In selecting glasses, the rules ordinarily applicable to cases of myopia and astigmatism hold good.

Glasses.

Attend to general health.

In the second place, we must do all in our power to improve or maintain the patient's general health. Lastly, we may lessen the secretion of aqueous, in bad and advancing cases, by iridectomy, the upper section of the iris being removed; nor should this operation be long delayed if its full advantages are to be gained. I do not assert that iridectomy will stop the progress of the affection, but in its early stages it affords us the best chance we have of checking it, especially in instances where the disease is making rapid progress.

Iridectomy.

V. Graefe's operation.[1]

Von Graefe recommends the following proceeding in cases of advancing conical cornea. The pupil having been fully dilated with atropine, a narrow-bladed knife is to be thrust into the middle layer of the cornea, at the apex of the cone, and then passed out again, so that a small superficial flap may be made. The anterior chamber is not to be punctured, but only the outer layers of the cornea raised and turned back, the flap thus formed being cut off at its base with a pair of scissors. If the cornea should by chance be punctured, the operation must be put off for a few days until the wound has healed. The day after the operation, the surface from which the flap of cornea has been removed is to be touched with a pencil of dilute nitrate of silver (nitrate of silver one part, nitrate of potash two parts), at first very lightly; this proceeding must be repeated every other day until an ulcer surrounded by a halo of infiltration is produced. The anterior chamber is then to be cautiously opened through the base of the ulcer. The perforation is repeated daily for three or four days, and then the eye is bound up, and the ulcer allowed to heal. The result is the

flattening of the excessive curvature, and the formation of a leucoma at the part of the cornea most affected. It may be necessary to displace the pupil subsequently by means of iridectomy.* With reference to operations of this kind, it is almost unnecessary to remark that they should only be practised in extreme cases of conical cornea.

Pellucid Protrusion of Cornea

Spherical Pellucid Protrusion of the Cornea, or Dropsy of the Aqueous Chamber, as it was formerly called, is a very insidious disease, usually following an attack of acute granular conjunctivitis, or keratitis; the toughness of the fibrous structure of the cornea, and therefore its power of resisting the intra-ocular pressure, having been diminished by disease, it slowly yields to the distending force, so as ultimately to bulge forward to a greater or less extent. The pathological condition we are now considering differs essentially from conical cornea in being preceded by some acute affection of, or injury to, the parts; sometimes it arises from deep-seated disease which has produced augmented intra-ocular pressure, and at the same time defective innervation of the cornea by involving the ciliary nerves. In some rare instances it appears to be a congenital affection: I know of a family at present, in which it exists to a most distressing extent, both sons and daughters being equally affected.

follows some acute affection.

Sometimes congenital.

Sclerotic involved.

In most cases of pellucid protrusion of the cornea, the sclerotic is also involved, the whole front of the globe bulging forwards; the breadth as well as the convexity of the swelling is thus augmented to such an extent, that it is often impossible for the lids to close over it. Ultimately the cornea may become opaque, and will probably be destroyed by progressive ulceration.

Iris affected.

In the early stages of this disease the functions of the iris are often impaired; it responds but slowly to the stimulus of light, and synechia subsequently forms between it and the lens. The patient seldom suffers from pain during the progress of this affection; but as the cornea becomes more prominent, he com-

* *The Practitioner*, vol. ii. p. 176. Mr. R. B. Carter on Conical Cornea, *Lancet*, February 6, 1869.

Myopia.

plains of increasing myopia, and experiences a sensation of distension in the orbit, particularly when he attempts to rotate the eye from one side to the other, the enlarged globe turning with difficulty in its socket; and in addition we shall have glaucomatous changes going on in the eye.

*Treatment.*

Most unsatisfactory.

*Treatment.*—Cases of spherical protrusion of the cornea are almost hopeless ones. In the early stages of the disease, we may endeavour to stay its progress by tonics and similar means, hoping to improve the nutritive powers of the patient, and thus stop the local degeneration of the cornea and parts around it.

Iridectomy or paracentesis.

Iridectomy would be indicated in a rapidly advancing case; but I fear it would be attended with little, if any, permanent advantage. Repeated paracentesis of the cornea has been recommended, so as to keep the anterior chamber comparatively empty, and thus diminish the intra-ocular pressure.

Draw off aqueous slowly.

If we perform either paracentesis of the cornea, or iridectomy, in instances of this kind, it is advisable to draw off the aqueous slowly, so as to allow of a gradual diminution of the intra-ocular pressure; otherwise, the bloodvessels of the choroid, being most probably diseased, may suddenly give way, and destructive hæmorrhage occur, necessitating the excision of the globe. By drawing off the aqueous very slowly, we diminish this risk, the intra-ocular circulation adapting itself by degrees to the gradually diminishing tension of the eyeball.

Abscission.

Should the disease have advanced so far as to interfere with the action of the lids, the sight of the eye being destroyed, it will be better to excise the anterior half of the globe. This will be the more desirable if the other eye is not affected, which we may thus hope to save from sympathetic irritation.

## WOUNDS AND INJURIES OF THE CORNEA.

Injuries of Cornea.

Injuries of the Cornea.—Mr. White Cooper* remarks, that wounds of the cornea present themselves of every size, from the minute puncture of the surgeon's needle, which does not even

* W. White Cooper on "Wounds and Injuries of the Eye," p. 98.

cause the escape of the aqueous humour, to cuts and lacerations the most extensive; but there is no puncture or scratch, however slight, which is devoid of risk; and no wound, within certain limits, from which the eye may not recover under favourable circumstances. The earlier the age the greater are the restorative powers, and if the patient is healthy, the less disposed is the eye to take on inflammation; even in advanced age, the recovery from wounds of the cornea is often surprising.

ABRASION OF THE CORNEA is by no means an uncommon accident; any foreign body, striking the surface of the cornea, may scratch off a portion of its epithelium. These corneal abrasions are often followed by acute pain in the eye, and sometimes, in neglected cases, by destructive inflammation. The patient usually comes to us with the eye firmly closed, suffering from considerable pain, lachrymation, and photophobia, and complaining of a sensation as if a foreign body were lodged in the eye.

Abrasion.
A common accident.
Very painful.
Photophobia.

The moment the lids are opened a gush of tears takes place from the eye, and the palpebral and orbital portions of the conjunctiva will be found more or less congested. If the cornea be examined by oblique light, we may notice that the abraded portion has a glistening appearance, and is surrounded by a slight ridge, occasioned by the free margin of epithelial cells bordering the injured part. The outline of the excoriation is generally very irregular, and its size will vary according to the extent and nature of the injury.

Appearance of the part.

A simple abrasion of the cornea, if it occurs in a healthy person, and is properly treated, generally heals in the course of three or four days; the epithelium is re-formed, and the parts assume their normal condition. But if the patient be out of health at the time of the injury, or if the case be carelessly treated, simple abrasion may induce troublesome keratitis, even leading to ulceration or abscess of the cornea.

Quickly repaired in health.
May suppurate.

*Treatment.*—In a case of abrasion of the surface of the cornea, it is well to open the lids and drop some olive oil into the eye, then smear the extract of belladonna over the lids, and lastly, apply a pad of cotton-wool and a bandage, so as to keep the parts at rest for twenty-four hours. If after this the patient continues

*Treatment.*
Oil.
Belladonna.
Rest.

to suffer from pain, it will be advisable to drop a solution of atropine into the eye, and order poppy-head fomentations to be employed frequently, the pad and bandage being applied in the interim.

After an accident of this kind, if the irritation has run on to inflammation or ulceration, we shall have to treat the case upon precisely the same principles as those I have already laid down, when discussing the subjects of keratitis and ulceration of the cornea. In abrasion of the cornea no irritant lotion should on any account be used; rest is the chief means we must employ, and if this be attained, in most cases the epithelial cells will very soon be reproduced, and the functions of the eye restored.

Contusions rare.

Contusions of the Cornea resulting from direct injury are uncommon, on account of the rapidity with which the lids close and prevent the impact of a foreign body upon the eye. Nevertheless, cases of contusion of the cornea do occur, and

May be followed by suppuration.

in old and sickly people are at times followed by rapidly advancing destructive changes in the part, independently of complications, such as detachment of the retina or choroid, which are likely to take place under the same circumstances. After contusion, the cornea may rapidly assume a hazy appearance, the patient suffering great pain in the eye, and the conjunctiva becomes deeply congested; in unfavourable cases, these changes may run on into suppurative keratitis, in spite of our best efforts to prevent it; and if necrosis of the cornea commences under these circumstances, it will almost certainly terminate in the entire destruction of the eye.

Penetrating Wounds.

Penetrating Wounds of the Cornea, provided they are not complicated with prolapse of the iris, will, if their edges fall into accurate apposition, usually heal rapidly. On the other hand, wounds with jagged edges, or those accompanied with loss of substance, heal with difficulty; and, as a rule, an opaque cicatrix remains to mark their position on the cornea, and materially interferes with the patient's sight if it be situated in the axis of vision.

Heal well if edges fit.

The complication which principally interferes with the healing

of wounds of the cornea is a prolapse of the iris, preventing the apposition of the edges of the wound, and thus involving the iris to a greater or less extent in pathological change. Unfortunately, in extensive wounds of the cornea, it is often impossible to replace the iris in the anterior chamber: if it be thus replaced, the aqueous, accumulating, is apt to burst open the edges of the wound, and as the fluid escapes, the elastic vitreous pushes the lens and iris forwards against the cornea, and a further prolapse occurs.

Prolapse of iris may occur.

*Treatment.*—Theoretically we might suppose, that to dilate the pupil with atropine, or to contract it with eserine, so as to drag the iris away from the wound in the cornea, would be a rational and effective plan of treatment. Unfortunately, the iris will seldom dilate under the influence of mydriatics, however powerful they may be, if the anterior chamber is empty, and the iris compressed between the cornea and the lens. Atropine, therefore, although it should always be employed, is not often of much use in extensive wounds of the cornea; in small ones it may be useful, as it is possible that the pupil may then be made to dilate, and the edges of the wound in the cornea falling into apposition, the aqueous is retained, and the full effects of the drug may then be induced so as to draw and keep the iris away from the rent in the cornea.

*Treatment.*

In large wounds atropine inert.

In instances of wounds of the cornea not complicated with prolapse of the iris, a solution of atropine should be dropped into the eye, three or four times a day; it tends to soothe the irritation, and, together with a carefully applied pad and bandage, keeps the eye at perfect rest. Should there be pain or irritation, the eye may be fomented with a decoction of poppy-heads; and one or two full doses of opium administered. If, in spite of this, the pain in the eye continues, a few leeches applied to the temple will often give relief.

Apply atropine and compress.

In severe wounds of the cornea, whether they be contused or incised, we should always be prepared to find that detachment of the retina, or some such serious complication, has occurred in the deeper structures of the eye.

Deeper complication.

If the wound in the cornea is a *small and recent* one, and a nodule only of iris protrudes through it, we may be able to

In small, recent wounds,

return the iris.

return it into the anterior chamber.* Under these circumstances it will be well to puncture the prolapsed iris with a broad needle; we thereby relieve any slight congestion of its protruding vessels, and allow the aqueous to escape from behind it—both important points to be attained; atropine must then be applied to the eye, and a pad and bandage carefully adjusted. But we cannot expect success from this proceeding in large wounds of the cornea, where a considerable extent of the iris is prolapsed; and even if we excise the prolapsed iris, as above directed, there is always a risk that the wound in healing will retain a portion of the iris in the cicatricial tissue, which may be the means of setting up sympathetic irritation in the sound eye—a disaster against which the surgeon can hardly be too much on his guard. The method of treatment which is most generally applicable in these cases, is to perform an iridectomy, removing the protruded portion of the iris, and thus preventing the chance of a further prolapse, or the ill consequences arising from the iris becoming involved in the cicatrix. But in performing an iridectomy under these circumstances, we must bear in mind the fact, that there is no anterior chamber, the lens being thrust against the posterior surface of the cornea; to make an iridectomy, therefore, the patient must be placed under chloroform so as to relax the muscles, no stop speculum can be used, and the section in the cornea must be performed with a very narrow-bladed knife, which can be made to transfix the margin of the cornea only, thus keeping clear of the lens.

Iridectomy preferable to excision.

If, as will certainly be the case in most extensive wounds of the cornea, a traumatic cataract exists, and the patient retains only a perception of light, the sooner the globe of the injured eye is removed the better.

FOREIGN BODIES IN THE CORNEA.—It frequently happens that particles of dust, bits of coal, straw, and such like substances find their way into the eye, and becoming fixed in the epithelial layers of the cornea, excite considerable irritation and pain, intolerance of light, and profuse lachrymation. There is generally but little difficulty in detecting the presence of a foreign

FOREIGN BODIES

cause much irritation.

* W. White Cooper on "Injuries of the Eye," p. 107.

body on the cornea, especially if the part be examined by the lateral method of illumination ; and the sooner an offending particle is removed from this situation the better, for the patient by constantly rubbing at the lid, is apt to drive the offending substance deeper into the cornea, and it may then give rise to severe inflammation of the eye.

When consulted in cases of this kind, the surgeon should seat his patient in front of a good light, and standing behind him, with the aid of an assistant, he should keep the eyelids wide open, the patient being at the same time directed to look steadily forwards ; with a small spud or cataract needle, the surgeon may then pick the offending particle off the cornea. If it happens to have been a little bit of iron, or coal, or in fact any substance likely to stain the cornea, although the particle is detached, the discoloration may remain, and we should not attempt its removal ; it will wear away in the course of a few days, as new epithelial cells are formed.

Easily removed if superficial.

Stains may be left.

It often happens, in cases of this kind, that before we see the patient, the foreign substance has been lodged in the eye for some days, and has set up so much irritation that it is utterly impossible for the patient to hold his eye steady for an instant, in order that the surgeon may remove the foreign body. Under these circumstances, it is well to give the patient chloroform or ether, and the operation may then be completed without any difficulty. If there should be any objection to chloroform, better apply a stop speculum to the eye, and having fixed the eyeball with a pair of forceps, we can command the movements of the globe, and quickly effect our object. After the removal of the foreign particle from the cornea, a few drops of castor-oil may be dropped into the eye, and the lids kept closed for twenty-four hours with a pad and bandage.

Apply oil, pad and bandage.

*Cases of Impaction.*—The foreign body may, however, strike the cornea with sufficient force to be driven deeply into the laminated tissue, and it then gives rise to the most severe irritation, and it may be, inflammation of the eye. The hyper-action thus induced may become localized around the offending particle, and suppuration taking place, it is gradually loosened from its position by the disintegration of the surrounding tissue, and so

If deep, may escape by suppuration,

cast out of the eye. An ulcer thus formed usually heals tolerably quickly, a small nebulous spot remaining to indicate the position the foreign body occupied.

or cause an abscess.

In other cases, no such localization of the inflammation occurs around the offending particle, but spreading from the seat of injury, it gradually involves the whole cornea, and ultimately the deeper tissues of the eye, terminating in general inflammation of the globe.

Remove at once with needle.

When called to attend a case where a foreign body has become impacted in the cornea, our first duty is obviously to remove it as soon as possible. If the eye is painful and irritable, it will be advisable to administer chloroform; and the point of a cataract needle, or spatula, being inserted beneath the foreign

Often firmly fixed.

body, it is to be lifted from its bed. It is surprising how firmly particles of iron or dust may become wedged into the laminated tissue, and without the aid of chloroform, it often requires the greatest patience on the part of both surgeon and patient to dislodge them. After removal, the eyelids must be kept closed for a day or two with a pad and bandage.

If the foreign body has given rise to abscess or suppuration of the cornea, the case must be treated upon the principles already laid down with reference to these affections (p. 202).

Seldom become encysted.

It does not often happen that foreign bodies become encysted in the cornea, but occasionally we meet with instances of the kind. Thus, a grain of gunpowder, or some such substance, becomes imbedded in the cornea, and probably gives rise to some slight irritation in the first instance; this gradually subsides, and the particle remains encysted, causing no further inconvenience. Under these circumstances it would hardly be wise to attempt its removal; but these are exceptional cases, and by no means invalidate the general rule, that a foreign body should be extracted from the cornea as soon as possible.

Perforation of cornea.

*Perforation of the Cornea.*—We sometimes meet with instances in which a chip of steel, or other hard substance, has been driven against the cornea with sufficient force to perforate

Wounds of iris or lens.

it, the inner extremity of the foreign body wounding, perhaps, the iris and lens. It is upon a consideration of the size and position of the particle, and the complications to which it may

give rise, that our prognosis and treatment must be based. If the foreign body is a large one, it will excite much more irritation and inflammation in the eye than a smaller one would do. So again with regard to its position—if in the axis of vision, it will almost certainly injure the cornea, to such an extent as to interfere with the subsequent perfection of vision. Prognosis from size and position.

So far the features of such a case are sufficiently obvious; but it requires a certain amount of experience, and a careful study of the parts, to determine if a foreign body, which has perforated the cornea towards its circumference, has wounded the iris or lens. In most cases where the cornea is thus transfixed, the aqueous escapes, and the iris and lens are thrust against the inner extremity of the foreign body, and thus placed in imminent peril. From escape of aqueous.

The intense pain, intolerance of light, and lachrymation to which these more serious injuries of the cornea give rise, render it necessary to administer chloroform before making our examination, in order that we may be enabled to inspect the parts thoroughly, as well as to assist us in removing the foreign body. Examine under chloroform

The lids having been separated we must examine the seat of injury by transmitted light; the position and relations of the foreign body are thus to be carefully studied. If the iris is in its normal position, being well away from the cornea, the aqueous humour still fills the anterior chamber, and the inner extremity of the foreign body, unless it be of some considerable length, may not have wounded the iris or lens. Under these circumstances the case will be a comparatively simple one, provided no deep-seated inflammation of the eye has been excited. On the other hand, we may discover or suspect, from the escape of aqueous or the depth the foreign body has penetrated, that the iris or lens has been wounded. If the iris has suffered, the case may be complicated by iritis: and if the capsule of the lens has been injured, a traumatic cataract will add still further to the difficulties we shall have to contend with. by transmitted light.

Supposing, however, that both the iris and lens have escaped injury; having the patient still under the influence of chloroform, we may generally lay hold of the foreign body with a pair of forceps, and remove it from the eye without difficulty. If simple, remove with forceps.

If from the patient's endeavours to rub the foreign body out of his eye, he has driven its outer extremity inwards, flush with the cornea, or it may be deeply into its laminated tissue, it is frequently impossible to seize hold of it with a pair of forceps ; any forcible attempts to do so would probably drive it completely into the anterior chamber. It is advisable, under these circumstances, to enlarge the wound in the cornea, and then seize hold of the foreign body and remove it. It has been recommended, in cases of this description, to pass a broad needle through the margin of the cornea, the flat blade of the instrument being inserted beneath the inner extremity of the foreign body ; the latter may thus be pushed outwards, and taken hold of with a pair of forceps. A powerful magnet has been used with success to draw a chip of iron imbedded in the cornea from its position.

If deep, employ a needle.

Atropine.

Pad and bandage.

A solution of atropine should subsequently be dropped into the eye, three or four times a day, so as, if possible, to keep the iris away from the wound in the cornea, and a pad and bandage should be carefully applied. If the eye is much inflamed, cold compresses may with advantage be used, and opium must be administered internally, so as to allay the irritation in the part. Leeches will be necessary if the inflammation runs high.

If on examining the eye we find the foreign body has wounded the iris or lens, but can still be withdrawn from the cornea, we shall, of course, lose no time in removing it ; but if it has fairly passed through the cornea, and fallen into the lower part of the anterior chamber, or is seen sticking in the iris, we can no longer hope to seize it with the forceps ; having once passed through the cornea the elastic lamina closes over it, and defeats all our attempts to get at it in this way, and a different method must be employed. The management of these cases will be found described under the head of Wounds of the Iris, the corneal injury being a matter of secondary importance.

If in anterior chamber, use other means.

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Arcus Senilis.

Senile Degeneration of the Cornea.—This condition of the cornea is characterized by the presence of the *arcus senilis* or white margin, which Mr. Canton describes as follows : "The arcus senilis, if closely examined, will be found to be

composed of two parts, the outer having a greyish white, or dusky tint, the inner one being milky in colour. These are separated from each other by a clear, unaffected line of cornea, and through this the iris can be distinctly seen."* Appearance of.

This alteration in the margin of the cornea usually commences in its upper section, and in both eyes at the same time; subsequently the lower portion is similarly affected, so that the eye then presents two white crescents, an upper and a lower one; they gradually advance, and ultimately coalesce, and the cornea is then surrounded by a whitish band as above described. This band usually extends only a short distance from the margin of the cornea, but in some instances it encroaches on the more central parts, and may involve a considerable portion of the cornea, but such cases are rare. Progress.

This condition is not to be confounded with the grey line which corresponds to the border of the sclerotic, where it is bevelled off to overlap the cornea: the true arcus senilis depends upon fatty degeneration of the cornea, its transparent structure being converted into a semi-opaque band, of the extent and configuration depicted in Fig. 39.

FIG. 39.

Due to fatty degeneration,

As a general rule, the arcus does not appear before a man has reached the age of forty-five or fifty, but it may come on in younger people; when it does so, it may be taken as an indication of a constitutional tendency to fatty degeneration of the tissues. There can be no doubt that the arcus senilis is hereditary; that is, the gouty or other diathesis upon which it depends passes from parent to child, and with it the tendency to early fatty degeneration of the cornea, the muscular tissue of the heart, and other organs of the body. from age or hereditary tendency.

I am not aware of a single instance in which this disease has advanced so far towards the centre of the cornea as to interfere Does not interfere with vision,

* E. Canton on "The Arcus Senilis, or Fatty Degeneration of the Cornea," p. 6.

or operations.

with the perfection of vision. I cannot say that in operating for cataract, the presence of an arcus senilis influences me in the selection of one or other of the various modes of removing the lens ; I have frequently performed the flap extraction with the most favourable results, although an extensive arcus senilis has been present.

Instances have been recorded of an arcus senilis disappearing under a course of treatment calculated to increase the vigour of mind and body, among those whose constitutions have been impaired from over-work, ill-health, and other depressing influences.

LEPROUS AFFECTIONS OF THE CORNEA.—Among the natives of India, and in fact among all classes affected with leprosy, it often happens that both corneas become nebulous, the opacity commencing at the extreme margin of the cornea, and extending year by year towards the axis of vision : vessels may from an early stage of the disease be seen protruding from the subconjunctival zone into the cornea, and from time to time these vessels become much congested, the hyperæmia lasts for a month or two and then subsides ; but after each attack of this kind the opacity of the cornea increases both in extent and density, and so the patient's sight is slowly but surely lost for all practical purposes.* Changes in the transparency of the cornea such as I have above described are due to the growth of leprous elements in the tissue of the cornea, and consequently we can only hope to influence the condition of the eye by acting on the primary cause of the disease. I have seen so many leprous patients improve under a long continued course of tonics, combined with arsenic, change of climate, and a generous dietary, that I am by no means disposed to abandon cases of leprous opacity of the cornea to their fate. We cannot cure the disease, but I am persuaded we can often stop its progress for

* Some years since, I sent a patient suffering from leprous disease of the cornea to Mr. J. Hutchinson, and from this patient, Plate XXIX. was drawn of the series of Chromolithographs of Diseases of the Skin, published by the New Sydenham Society.

years, if not for life, and thus preserve the eye among other organs of the body from destruction.

*Leprous Tubers of the Cornea* are seldom met with unless similar growths are seen springing from the iris. They commence as small pale elevations situated on the margin of the cornea; as the little tuber grows it becomes vascular, and gradually extends itself over the surface of the cornea. Both eyes are, as a rule, attacked, and the tubers are placed symmetrically on corresponding spots of the cornea, they take years to grow, but nevertheless surely and gradually increase in size until they entirely cover the cornea. As far as my experience goes, treatment is of little avail in this form of leprosy; an eye once affected by tuberous growths will, in spite of all we can do, gradually be destroyed. Nor is it of any advantage to excise these leprous tubers—they are certain to grow again, even if the base of the excised tuber is freely attacked with chloride of lime. Leprous tuber of the iris and cornea is, without exception, one of the least hopeful affections of the eye we have to deal with; the only consolation in cases of the kind is, that the progress of the malady is frequently a very protracted one.

## CHAPTER IX.

### DISEASES OF THE IRIS.

*Hyperæmia—Plastic, Serous, Parenchymatous Iritis—Treatment—Synechia, Treatment of—Corelysis in Synechia—Iridectomy—Traumatic Iritis—Wounds of the Iris—Detachment—Tumours—Mydriasis—Myosis—Tremulous Iris—Hippus—Artificial Pupil—Excision of Iris—Iridesis—Iridectomy—Cyclitis—Plastic, Serous, and Purulent Cyclitis—Sympathetic Cyclitis.*

#### HYPERÆMIA AND INFLAMMATION.

Colour of healthy iris.

THE colour of the iris, depending as it does upon the amount and tint of the particles contained in its pigment cells, varies in different individuals. As a rule, the irides are of the same colour, but we occasionally meet with instances of a congenital difference in this respect, although they may be perfectly healthy.

Its texture.

Whatever the colour of the healthy iris, it has a brilliant shining, fibrous aspect, and any alterations in its textural character are symptomatic of disease, although the change may be so slight, that it can only be appreciated by comparing the diseased with the healthy eye (Plate I. Figs. 1 and 2).

Form and mobility of pupil.

The state of the pupil, again, is an important element for consideration in diseases of the iris and deeper structures of the eye. In the healthy eye the surfaces of the iris and its pupillary margin are free in the aqueous humour; the pupil has a circular form and a wide range of motion, quickly responding to every change

in the degree of illumination; but it frequently happens that, from inflammatory or other causes, adhesions form among the fibres of the iris, or between it and the capsule of the lens. Under these circumstances the action of its contractile elements is mechanically impeded, the mobility of the pupil impaired, and its circular form distorted. How impaired in disease.

But defective action of the pupil may arise from faulty innervation. Thus, affections of the retina, or of the choroid, by involving the long ciliary nerves, will influence the contractile power of the iris. Alterations, therefore, in the activity of the pupil, are not necessarily pathognomonic of disease of the fibrous structures of the iris, they may depend upon more remote influences, into which it would be foreign to my purpose to inquire at present.

HYPERÆMIA OF THE IRIS is the first departure from the healthy state which requires our attention, not that it often occurs as an independent affection, but it is a sufficiently constant feature of several maladies to deserve consideration. Thus, hyperæmia is occasionally met with as a result of injuries or wounds involving the cornea; but it is more often seen in the early stages of iritis, or of congestion of the choroid; and is not unfrequently described as chronic iritis. HYPERÆMIA. rarely idiopathic.

*Symptoms.*—Hyperæmia of the iris is characterized by the appearance of a rosy zone of finely injected vessels at the junction of the cornea and sclerotic; the extent and depth of coloration of this zone vary with the progress of the disease. The cornea remains transparent, so that there can be no mistaking this sclerotic or subconjunctival zone of small parallel vessels, in hyperæmia of the iris, for those of keratitis. "Sclerotic zone."

On examining the hyperæmic iris by transmitted light, we shall be able to trace distended vessels coursing over its surface. After long-continued hyperæmia, changes take place in the pigment-cells of the iris, similar to those noticed under analogous circumstances in the choroid; they become of a darker colour in patches. These alterations usually commence at the margin of the pupil, in the uvea covering the contractile fibres of the iris, which then assume an uneven and spotted aspect, Congestion of iris. Colour rarely altered.

small dark excrescences projecting into the pupil. The pupil responds but slowly to the stimulus of light or to weak mydriatics; but even after long-continued hyperæmia, the contractile elements of the iris seldom become disorganized; and no sooner does the congestion subside, than it again actively performs its functions.

Pupil sluggish.

Iritis.

Iritis, or Inflammation of the Iris (Plate I. Fig. 2).—I propose describing iritis under three heads: first (fibrinous) plastic iritis; secondly, the serous (sero-fibrinous hæmorrhagic); and lastly, the parenchymatous or purulent iritis.* Inflammation of the iris is accompanied by certain symptoms common to all forms of the disease, and which it will be convenient to describe under distinct headings, so as to save the necessity for recapitulation when giving the characteristic features of each variety.

Symptoms common to all forms.

*Pain* in the affected eye is a constant symptom of iritis, but varies considerably in degree in different cases. In many instances the patient complains of only slight uneasiness, extending from the eye over the corresponding side of the forehead, whereas in other cases the pain is excruciating, and of a throbbing, lancinating character, involving not only the affected eye, but the side of the head and face. The pain is increased when pressure is made on the eyeball.

Pain constant, severity variable;

*Sclerotic Zone.*—A rosy zone of congested subconjunctival vessels surrounds the junction of the cornea and sclerotic; hyperæmia of the iris exists in instances of iritis, and consequently congestion of this subconjunctival zone of vessels, since they anastomose with those of the iris and choroid. The amount of the subconjunctival congestion will vary with the severity and

Zone of sclerotic vessels.

* I have adopted this nomenclature, because it seems to me, on pathological grounds, to be sounder than that employed by some English surgeons, such as rheumatic iritis, syphilitic, and so on. But beyond this, the nomenclature is that of M. Wecker, Von Graefe, and the leading Continental authorities; and it is desirable to promote as much unanimity as possible in the profession on these matters. Lastly, so far from sacrificing principles or views which I deem to be important, I feel that my subject is simplified and best explained by the arrangement here employed.

stage of the inflammation; in some cases it may be concealed to a great extent by the injected and chemosed conjunctiva. Ultimately, as the iritis passes off, and the balance of the circulation is restored, the sclerotic zone of vessels disappears.

*Dimness of Sight* is another symptom of iritis; it depends in the first instance upon turbidity of the aqueous. Another cause of the haziness of vision consists in the changes which take place in the epithelium of the posterior elastic lamina of the cornea, and which are best detected by the lateral method of examination; these cells often present a hazy appearance, similar to those of the anterior layers of the cornea in keratitis. In instances of this kind, flakes of degenerated and detached epithelium may sometimes by means of transmitted light be seen floating about in the aqueous. In the further progress of iritis, bands of adhesion form between the iris and the capsule of the lens, giving rise to the condition known as synechia. In this way the pupil is sometimes closed, and the sight is consequently very imperfect.

Dim vision, from turbid aqueous and post-corneal haze.

*Changes in the Colour and Texture of the Iris* are noticeable in all cases of iritis; a blue or grey iris becoming more or less greenish, a green iris yellowish green, and a dark brown iris of a reddish hue. The brilliant fibrous aspect of the healthy iris is also destroyed, being exchanged for a confused and muddy appearance, as may be seen by contrasting Figs. 1 and 2 of Plate I. These alterations are rendered more apparent by comparing the diseased with the healthy eye (provided only one eye is affected); but, under any circumstances, the change in the colour and brilliancy of the iris is unmistakable in all instances of iritis.

Change of colour in iris.

*Alteration in the Mobility and Form of the Pupil.*—The congested state of the vessels, together with the serous effusion that occurs in the early stages of inflammation of the iris, necessarily impair the functions of the contractile elements of the iris, and consequently its mobility; hence a defective response of the iris to the stimulus of light is an early symptom of iritis. Subsequently, as adhesions form between the iris and the lens, they not only impede the action of the former, but when under the influence of atropine, the pupil assumes an irregular figure, or,

Pupil sluggish or irregular from synechia.

it may be, is unable to dilate, being closed by organized bands of lymph. From the commencement, therefore, and throughout the course of an attack of inflammation, the iris responds but slowly and imperfectly to the stimulus of light or to mydriatics.

Intolerance of light.

*Intolerance of Light and Lachrymation* are symptoms so frequently met with in iritis, that they may be considered as being common to all its forms. In chronic or subacute cases they may be hardly noticeable, whereas in the active stages of the more acute forms of the disease the patient complains of the exacerbation of pain which he experiences the instant he approaches the light, and he is perpetually wiping away the tears that flow down over his cheek.

Congested conjunctiva.

*Congestion of the Conjunctiva* is always present to some extent in iritis, and in many instances its vessels are so deeply injected, that it is well nigh impossible to distinguish the sclerotic zone surrounding the cornea. In these cases, if the posterior layers of the cornea are also affected, the condition of the iris, which is the real centre of disease, is apt to be overlooked. Any doubts that may exist as to the nature of the affection can be cleared up by employing the lateral method of examination, or by applying a solution of atropine to the eye; the irregular way in which the pupil dilates will then be apparent.

Atropine as a test.

Increased tension.

*Increased Tension* of the eyeball is present in most cases of iritis, especially in the serous form, and is one of the chief causes of the pain from which many patients suffer.

Plastic Iritis.

Plastic or Fibrinous Iritis (Fig. 2, Pl. I.)—This form of inflammation is marked by fibrinous exudation from the iris; the increased cell formation commences in the connective tissue cells of the stroma of the iris, and together with that arising from cells directly emanating from the blood, cause the iris to swell; this swelling of the iris is increased by serous effusion into its tissue.

Neo-plastic formations.

The characteristic feature of plastic iritis is, that the exudation, both on the surface and in the substance of the iris, tends to become developed into a kind of pseudo-membrane; bands of adhesion are thus formed between the iris and capsule of the lens (synechia), and in the contractile tissue of the iris itself. The exudation is in the first instance found principally upon the

pupillary region ; subsequently on the posterior, seldom on the anterior surface of the iris.

Under favourable circumstances this form of disease may run its course in from ten to fifteen days, and then gradually disappear. Instances of this kind are, however, exceptional, unless the patient has been brought under treatment at an early stage of the affection. The majority of cases of plastic iritis, if left to Nature, terminate in synechia : slight adhesions form in the first instance between the pupillary margin of the iris and the lens, which, however, are sufficient to tie the iris firmly down to the capsule at one or more points. Every time that the pupil dilates or contracts, these tags of adhesion pull on the iris, thus keeping up a constant state of irritation in the part, which ultimately induces a fresh attack of inflammation : more extensive adhesions form, until, after repeated attacks of this kind, the iris becomes firmly bound down to the lens. Degenerative changes then take place in the fibrous structure of the iris, which ultimately becomes atrophied. Unfortunately, the mischief that occurs under these circumstances does not stop here ; the communication between the anterior and posterior chambers of the eye being closed, an abnormal collection of fluid takes place behind the iris, which exercises an injurious effect on the deeper structures of the eye.

Synechia and its effects.

Atrophy of iris.

*Symptoms.*—As a rule, the zone of subconjunctival vessels surrounding the circumference of the cornea is well marked in cases of plastic iritis, the hyperæmia of the conjunctiva not being sufficiently great to completely hide it.

Peri-corneal injection.

In the early stages of the disease the mobility of the iris is affected, its free margin appears to be swollen and thickened, its fibrous structure loses its distinctness, and its colour is likewise altered. The amount of exudation varies in quantity in different cases : it is first deposited on the posterior surface of the iris, and may add to the uniformly hazy, swollen condition of that structure, but is otherwise not distinguishable. In other instances, the exudation forms small papillary excrescences on the surface of the iris, particularly at its pupillary margin : if numerous, these run into one another, and reaching over the pupil cover the centre of the capsule of the lens with a pseudo-membrane ;

Mobility of iris impaired.

Neo-plastic matter not always obvious.

under any circumstances the exudation is apt to form adhesions between the margin of the pupil and the capsule of the lens. These papillary excrescences of plastic iritis are often mere specks which can hardly be seen by the unaided eye, particularly when the iris contains an abundance of pigment cells; so that we may not be able to detect their presence by simple inspection, but only by the changes effected in the appearance and activity of the iris, and in this respect the plastic iritis differs from the parenchymatous variety.

Pain uncertain.

The amount of pain from which a patient affected with this form of iritis suffers, is by no means constant; in some cases, it is not a prominent symptom, whereas in others the pain is excruciating, extending from the affected eye over the temple and side of the face, and almost always increasing in intensity towards evening, and growing gradually worse as the night advances.

Serous Iritis.

SEROUS IRITIS.*—In this form of iritis the transudation of serous fluid containing leucocytes takes place into the meshes of the iris, and subsequently into the anterior and posterior chambers of the eye. The functions of the iris are impaired,

Pupil slow, but regular.

and the pupil responds but slowly to the stimulus of light; in the early stages of the disease it often dilates regularly. In the more advanced cases the uveal layer of the iris is apt to become closely adherent to the lens, and fluid collecting behind it, its outer attachments are dragged forwards. This traction on the

Glaucoma apt to follow.

outer attachment of the iris probably causes symptoms of glaucoma, the iris under these circumstances exercising so much traction on the tissues forming Schlemm's canal as to obliterate it and the neighbouring lymphatic spaces (p. 8).

Symptoms obscure in early stages.

*Symptoms.*—Serous iritis causes no urgent symptom in its early stages; the zone of sclerotic vessels may be only slightly

* Formerly described as "aquo-capsulitis." One form of aquo-capsulitis, in which the pathological changes are most apparent on the posterior surface of the cornea, has been already described under keratitis punctata. In that now referred to the iris is principally affected.

injected, and the conjunctiva unaffected; the disease is not unlikely, therefore, to be disregarded until it has effected irreparable changes in the deeper structures of the eye.

Attacks of serous iritis are apt to recur: at first they are but slight, and of comparatively short duration, lasting probably from three weeks to a month, and then gradually passing away; and it may be some time before another attack, generally of increased severity, comes on. Recurring attacks.

The intra-ocular pressure, which is hardly augmented in the early stages of the disease, becomes a more prominent feature in each successive attack; the tension of the eyeball, however, increases so gradually, that the parts have time to adapt themselves to the distending force, and consequently the pain, though often severe, is not of so excruciating a character as that noticed in instances of acute serous choroiditis. Slow increase of tension.

Dimness of vision is always an early complication of serous iritis,* and depends on turbidity of the aqueous, which frequently assumes an appearance as though small particles of finely powdered chalk had been suspended in it, and of course prevents many of the rays of light, which would otherwise reach the retina, from arriving at their destination. This state of things is augmented by a semi-opaque condition of the epithelial cells lining the posterior elastic lamina of the cornea; we have, in fact, very much the condition of the parts described in the last chapter, as keratitis punctata, with the serious addition of iritis. The diseased epithelial cells drop off from the cornea after a time, and may then be seen as small white particles floating about in the turbid aqueous. The corneal haze and muddy aqueous, which are thus produced, tend to conceal the condition of the iris, and render the diagnosis of this affection in its early stages somewhat obscure. Dim vision. Posterior keratitis. Turbid aqueous.

As the disease advances the uveal layer of the cornea becomes adherent to the lens; it may be only at its pupillary edge, but not unfrequently the whole of the posterior surface of the iritis adheres to the capsule.

In some cases of serous iritis numerous hæmorrhages occur

* "Iconographie Ophthalmologique," par J. Sichel, p. 12.

from the iris; and the contents of the anterior chamber are stained with blood.

PARENCHYMATOUS IRITIS.

PARENCHYMATOUS IRITIS.—The characteristic feature of this form of inflammation is that the exudation is little more than cells and granular organic matter leading to the formation of well-defined nodular masses on the iris. These excrescences vary in size, in some instances being no larger than a pin's head: whereas in other cases they cover the greater portion of the iris, and bulge forwards, so as to touch the cornea. In the early stages of the disease, these excrescences are usually of a reddish-brown colour; subsequently they assume a yellowish tinge. They may either become absorbed or suppurate: in the former case the iris may return to its normal condition; but we seldom meet with a case of this kind: more often cicatrices form in the iris, and extensive synechia is the result of this form of inflammation. On the other hand, should the new formations of parenchymatous iritis suppurate, the pus gravitates to the lower part of the anterior chamber, forming an *hypopion*.

Neo-plastic out-growths,

may suppurate, or end in synechia.

Hypopion.

The breaking down of the nodular masses is not, however, the exclusive source of pus-like matter in iritis: sometimes the products of cell proliferation on the surface of the iris have from the first the characters of pus. In other cases, the posterior elastic lamina of the cornea contributes to its formation.

Parenchymatous iritis may often be traced to the effects of syphilis; syphilitic iritis is, in fact, the most familiar variety of the parenchymatous affection. In the hereditary form the disease usually manifests itself before the little patient is more than a few months old.*

Often syphilitic;

In all instances in which parenchymatous iritis arises from syphilis, we may expect to find the cellular excrescences particularly well defined. The nodules observed on the iris under these circumstances are neither more nor less than "gummy tumours," similar to those met with in other parts of the body

"Gummy" character.

* "Syphilitic Diseases of the Eye and Ear," by J. Hutchinson, p. 18.

as a result of syphilis.* Our diagnosis will of course be confirmed, in instances of this description, by the history of the case and the existence of constitutional symptoms, but still the condition of the iris alone will lead us at once to entertain suspicions as to the origin of the disease.

Other causes.

It does not follow, however, that parenchymatous iritis may not result from other causes than syphilis. In fact, we meet with cases of the kind arising from operations or injuries involving the iris, and from ill-defined causes. Moreover, a syphilitic taint may, without doubt, induce the plastic or serous form of inflammation, as well as the parenchymatous. It is a matter of some importance, therefore, to be careful how we employ the term syphilitic iritis, as it is apt to give rise to errors in regard to the treatment of the disease. The syphilitic character of an iritis can only be determined from the proof of the existence of constitutional syphilis.

Symptoms acute, with few exceptions.

*The Symptoms* which I have enumerated as common to inflammation of the iris are usually intensified in the affection now under our consideration. To this rule there are exceptions. Thus, we occasionally see parenchymatous iritis, especially among syphilitic patients, run a chronic or subacute course, without inducing any very prominent symptoms ; but being attended by nodular formations, it may end in extensive synechia. These, however, are exceptional instances of the disease : the symptoms generally present in parenchymatous iritis are more acute than in any other form of inflammation of the iris. The vessels of the iris, more particularly those covering the excrescences and surrounding their base, are engorged with blood, and the subconjunctival zone of vessels is proportionably congested ; the conjunctiva is often deeply injected, and considerable chemosis may exist. The aqueous is remarkably turbid, and flaky fragments of the neoplasms may often be seen floating about in it.

Vascular injection great.

Aqueous turbid.

Post-corneal haze.

In many cases, the posterior elastic lamina of the cornea

* The gummy nature of these nodules, at first conjectured by Virchow, has been confirmed by the observations of Colberg.—*Arch. für Augenheilk.*, t. viii. A. 1, p. 288.

becomes hazy; its epithelial cells, undergoing fatty degeneration, become white and opaque, presenting a spotted appearance. The brilliant fibrous aspect of the iris is destroyed, and its colour, as seen through the hazy cornea and muddy aqueous, is strikingly altered. One or more nodular excrescences will be observed on the iris; they vary in size and colour, as before described. The pupil is insensible to the stimulus of light, and if dilatable by the aid of mydriatics, it assumes an irregular shape; the functions of the nerves, vessels, and contractile fibres of the iris being impaired by the abnormal action going on in it, or from the presence of synechia, which tie it down to the lens or cornea.

Pupil inactive.

Pain severe.

The patient usually complains of pain in the eye and forehead from the commencement of the disease, subsequently the pain extends to the head and side of the face, and is often most excruciating, generally lessening during the day, but increasing in intensity as the night advances. Intolerance of light and increased lachrymation are also symptoms from which the patient suffers very considerably, a gush of tears pouring out of the eye the instant the eyelids are opened.

The symptoms above enumerated necessarily differ in different instances, and in the several stages of the disease; but though cases of parenchymatous iritis thus vary in intensity, they terminate but too constantly in irreparable damage to the eye. This may take place in various ways: the fibro-cellular excrescences may degenerate into pus, and give rise to an abscess of the iris, the result of which is the formation of a cicatrix of greater or less extent in the connective tissue of the part. In other instances posterior synechia form, which tend to keep up irritation and excite fresh inflammation in the iris, ultimately leading to complete closure of the pupil. Lastly, the outgrowths from the iris may reach forwards as far as the cornea, and adhesions form between the two, giving rise to anterior synechia.

Too often ends in abscess or adhesions.

*Prognosis in Iritis.* From type and progress.

*Prognosis in the Various Forms of Iritis.*—In the first place, the type of the disease, and the progress it has already made, must be considered; for iritis presents not only different stages,

but the disease is met with of very different degrees of severity. In slight and recent cases of iritis complete restoration may be predicted; in more serious cases the improvement can only be partial; in severe and neglected cases, it is but too often evident that we can hold out but slender hopes of complete recovery. Prognosis.

It is, however, to the presence and extent of the synechia that we should principally direct our attention in endeavouring to form a prognosis in cases of iritis. If bands of adhesion exist between the iris and lens, they too often lead to repeated attacks of inflammation, terminating in occlusion of the pupil and atrophy of the iris. And even supposing the synechia do not directly cause loss of sight, they may keep up irritation in the part, and thus induce congestion of the choroid, followed by degenerative changes in the eye. We are bound, under these circumstances, not only to give an unfavourable prognosis as regards the diseased eye, but to warn the patient of the danger he runs of losing the sight of the other eye, unless the source of irritation subsides. Look to synechia. Danger of sympathetic irritation.

Synechia being easily broken down in the early stages of serous iritis, it follows, that in this variety of the disease we may reasonably expect to save our patient's sight, if the case is brought sufficiently soon under treatment. We must bear in mind that vision is apt to remain confused and hazy for some time after an attack of this form of iritis, on account of the opaque condition of the posterior layers of the cornea, which, as I have before stated, is generally considerable. But provided the pupil dilates under the influence of a weak solution of atropine, we may assure the patient that this haziness will pass off, more particularly if there be no contraction of the field of vision. On the other hand, serous iritis, if allowed to run its course, may induce extensive synechia and increased intra-ocular pressure, more particularly when the diseased action extends to the choroid; it then becomes a serious affection, its danger being in proportion to the augmentation of the tension of the eyeball In serous form, prognosis mostly favourable.

In plastic iritis, if the adhesions are slight, or have only been recently formed, so that they can be broken through by dilating the pupil with atropine, we may form a favourable prognosis, although the patient's sight for a time may be impaired by In plastic, favourable, if synechia slight.

Plastic iritis. Synechia.

patches of uvea which remain adherent to the capsule of the lens, and form opacities of the posterior lamina of the cornea. It may be necessary to search carefully for the deposits of uvea before they can be recognized in cases of this kind; the pupil must be dilated as much as possible, and the lateral method of examination employed, or the deposits of uvea on the capsules of the lens may be overlooked; they may be seen with facility by the aid of the ophthalmoscope. If the synechia cannot be torn down by the action of mydriatics, much may still be done to improve the condition of the patient by an iridectomy, but our prognosis must, under these circumstances, be guarded: the patient's sight is never likely to be perfectly restored, and in too many instances will have been destroyed for all practical purposes.

In Parenchymatous, unfavourable,

In parenchymatous iritis, our prognosis, as a general rule, will be still more unfavourable, unless the disease be brought under treatment before it has made any great progress. It is true, some cases run a subacute course, giving the patient but little inconvenience, and leaving apparently no bad results behind them, but this is unusual; unless judiciously treated, the disease more commonly leads to multiple synechia and closed pupil.

unless pupil dilatable.

If, however, at any stage of the affection, we can dilate the pupil with atropine, we may with confidence expect a favourable issue, as we can then prevent the formation of synechia, and in all probability the further progress of the disease.

Iritis apt to recur.

In forming our prognosis, we should never lose sight of the fact that in all cases of iritis there is a tendency for the disease to recur, and that each successive attack is usually more severe than its predecessor, and more likely, therefore, to spread to the choroid, or leave its mark behind in the form of fresh synechia and atrophy of the iris.

Sight may be clear, yet synechia complete.

There is a deceptive condition of the eye, the result of iritis, in which the patient's sight remains good, although the iris is closely bound down to the lens by synechia. This arises from the fact that a small but clear opening remains through the pupil, and the rays of light reach the retina without hindrance; nevertheless, the sight is endangered from the closure of the communication between the chambers of the eye. Cases of this

kind are but rarely met with in practice ; we far more frequently see instances of closed pupil and extensive synechia, where the patient may have sufficient sight left to find his way about, but is unable to read or write with the diseased eye. If, under these circumstances, we fail to dilate the pupil with atropine, and if the tension of the eyeball is either increased or diminished, the prognosis cannot but be unfavourable ; the choroid, and probably the retina also, will have become implicated in the disease.

Mischief from closed pupil.

*The Causes of Iritis* are sometimes veiled in considerable obscurity. Plastic iritis is often produced by exposure to sudden changes of temperature, to damp and cold: we hardly ever see an instance of advanced leprosy in which plastic iritis is not present. Syphilitic patients, again, are subject to this form of iritis ; we see it also following blows or injuries to the eye ; in fact it is absolutely impossible to assign any constant cause for this disease. The same remark applies to parenchymatous iritis : we are no doubt justified in attributing it to a special cause, if the patient has had primary syphilis, and if the excrescences on the iris are particularly well defined ; but we shall, in practice, meet with cases which cannot be thus accounted for.* Serous

*Causes.* Leprosy. Syphilis. Injuries.

* Mr. Hutchinson makes the following remark regarding inherited syphilitic iritis :—"Respecting the frequency of iritis in infants, there can be no difficulty in admitting that it is among the rarest of the symptoms of hereditary syphilis. I am sure, however, that it often escapes notice. The absence of the sclerotic zone, and the very small amount of local symptoms which it causes, taken with the fact that infants usually keep their eyes shut, will account for this. In proof of it I may mention that, in 1852, I showed to a friend of mine, who had then for fifteen years held a surgical appointment, which brought under his notice vast numbers of the poor, the first case of syphilitic iritis in an infant which he had seen. The disease was new to him, and he was much interested in it. Since then he has had, in exactly the same field of observation, no fewer than five cases. Yet in proof, that however carefully looked for, it is really very rare, I may mention, that during four years' practice at the Metropolitan Free Hospital I have never treated a single case, although numbers of congenito-syphilitic patients present themselves, and I have scrupulously looked at the eyes in all."—*Ophthalmic Hospital Reports*, vol. i. p. 229.

inflammation of the iris probably depends upon alterations occurring in the lymphatic spaces of Fontana and Schlemm, and is not unfrequently complicated with cyclitis and choroiditis; for, as I shall subsequently explain, the diseased action may commence in the ciliary body and spread to the iris. Independently of any such complications, this form of iritis is most apt to occur among persons in a debilitated state of health.

Debility.

*Treatment,* will vary with the cause.

*Treatment of Iritis and its Consequences.*—After what has just been said as to the variety of conditions which may give rise to iritis, I need hardly repeat that, before commencing the treatment of any particular case, we must endeavour, if possible, to arrive at a definite conclusion as to its origin, otherwise our efforts to cure are likely to fall wide of the mark. There is usually no difficulty in recognizing the presence of a well-marked rheumatic, gouty, or syphilitic taint; but it is a far more troublesome matter to ascertain the nature of the case if a patient is suffering from any of those less definite ailments, induced by functional derangement of the secreting organs, which, by altering the character of the blood, interfere with the nutrition of the various tissues of the body. We must, nevertheless, attempt to master the subject, and also to right matters by the use of such remedial agents as we have at our command.

Mercury.

*Mercury:* It is seldom necessary to resort to the use of mercury unless in cases of iritis having a syphilitic origin. Mercury may be administered in the form of blue pill, or calomel combined with opium, or by inunction; for an adult half a drachm, or a drachm of the strong mercurial ointment being rubbed into the inside of the arms and thighs two or three times daily until the gums are affected. The latter, I believe, in the majority of instances, is the best plan of administering mercury in the class of cases now under our consideration. If it appears advisable to affect the system rapidly, on account of the severity of the case, two grains of calomel with the eighth of a grain of opium may be given by the mouth every three hours, for two days. It will be necessary, although lessening the quantity of mercury employed after the iritis has begun to subside, to continue its use for some time in small doses, our object being, if possible, to destroy the active principle of the disease, and thus prevent

Mode of administration.

the return of the inflammation. Subsequently the patient may with advantage be put on a course of iodide of potassium.

*Iodide of Potassium* has for many years been employed with such marked success in certain cases of syphilitic and rheumatic affections of the iris, that it deservedly holds a high position among the remedial agents at our command. In cases of inflammation of the iris of syphilitic origin, the iodide of potassium should be administered in ten-grain doses three times a day; and in cases depending on a rheumatic diathesis, it may be given in similar quantities; and in addition, these cases will generally be improved by lime-juice taken two hours after breakfast. Iodide of potassium.

*Salicylate of Soda.* — In cases of acute iritis occurring in rheumatic patients salicylate of soda, administered in ten-grain doses every three hours, frequently exercises a very marked influence on the disease. Salicylate of soda.

*Turpentine* has been extolled by surgeons of high repute as an invaluable remedy in cases of iritis occurring among persons of a rheumatic diathesis. A drachm of the oil of turpentine, or of the balsam of copaiba, given three times a day, apparently tends to allay the symptoms. Turpentine a reputed specific. Copaiba.

*Opium.*—In acute cases of inflammation of the iris with great pain, opium should be administered; probably, for an adult, one grain twice a day, would be about the dose required. Among younger patients, and in less urgent cases, it would of course be unadvisable to administer so large a quantity of opium as that above recommended; the dose must vary according to the circumstances of the case, its beneficial effects being more marked in acute form of iritis than in subacute cases. Opium invaluable in acute cases.

*Leeches* applied to the temple, and over the brow of an eye affected with iritis, will often exercise a marked influence on the progress of the disease, especially if the patient is suffering from much pain in the eye. It is by no means advisable, however, to apply leeches simply because a person is suffering from an attack of iritis. Should the general condition of the patient's health be such as to lead us to suppose he could bear loss of blood, four leeches may be applied over the affected eye, and the part should subsequently be well fomented with hot water, Leeches: relieve pain.

so as to encourage the flow of blood from the leech-bites. If this treatment appear to exercise a beneficial action on the disease, we may repeat it on the following day, often to the great relief of the symptoms. Cases of this description are likely to be much benefited by a dose or two of blue pill and colocynth, followed by a saline purgative in the morning, low diet at the same time being enjoined; in fact, the leeches will form a part of an antiphlogistic plan of treatment.

Purgatives and low diet.

In the instance of a patient already weakened by pain, and perhaps mercury, leeches might be injurious; they should consequently be used with caution, being like all such powerful means as useful in suitable cases as they are harmful in instances not requiring their employment.

Atropine invaluable.

*Atropine* is invaluable in the treatment of all cases of iritis, for if we can only manage to keep the pupil dilated, it is impossible for synechia to form; besides which, when the iris is well contracted on itself, forming a narrow rim round the anterior chamber, it follows that its bloodvessels can hardly remain in a state of congestion; they must, in fact, be pretty well emptied of their contents under these circumstances. The inflamed tissue is also kept at rest when under the influence of mydriatics —a most important point in the treatment of all kinds of inflammation. I know, indeed, of no remedial agent which places an inflamed structure in a more favourable position for recovery than atropine does in cases of iritis: it enables us to secure the inflamed part rest, it lessens the calibre of its congested vessels, and it prevents the injurious adhesions which otherwise follow an attack of plastic or parenchymatous iritis, by keeping the iris well away from the lens; and lastly, by lessening the vascular supply, and diminishing the amount of the secreting surface of the iris, it controls the secretion of the aqueous humour, and in this way lessens the intra-ocular pressure.

Insures rest.

Lessens congestion.

Prevents adhesions,

and tension.

If a case of iritis is brought under our notice before adhesions have formed, or the structure of the iris has become atrophied, we may with safety rely upon atropine as being the most efficient curative means at our disposal; a few drops of a solution of atropine, of the strength of one grain to two drachms of water, should be allowed to run into the eye every second hour, until

If early, may suffice for the cure.

Strength of solution.

the pupil is fully dilated. If the pupil once becomes dilated under this treatment, we may confidently hope to cure our patient in the course of a short time. In the more acute forms of the disease it is often a difficult matter to bring the pupil under the influence of atropine, and it may be necessary to continue its instillation every six hours, for a period of five or six days. In some instances the atropine is unable to act, on account of the swollen and congested state of the iris and conjunctiva; in these cases the prognosis will be less favourable, but we should endeavour to reduce the inflammatory action by mercury or iodide of potassium, and above all by the application of leeches to the temple, and then set to work again with the atropine.

Atropine

and leeches.

It is advisable not only to dilate the pupil, but to keep it dilated for some time after all acute symptoms have passed away; in fact, till the subconjunctival zone of vessels has disappeared, and the balance of the circulation in the iris has been restored.

Keep pupil dilated.

In many cases of iritis, the synechia is only partial, bands of adhesion existing between the iris and the capsule at certain spots, the remainder of the iris being sufficiently healthy to respond to the action of atropine. Under these circumstances, the pupil, in dilating, assumes all manner of shapes, expanding in one direction, and being prevented doing so in another by the adhesions. Atropine should be steadily and freely employed in cases of this description; the connecting bands are often broken through under its influence, and the existing iritis subsides; moreover, the synechia being destroyed, subsequent attacks of iritis will probably be prevented.

Limited adhesions broken down.

While, therefore, employing the various means at our command for improving our patient's health, and, if possible, acting on the cause which has induced the iritis, we should endeavour to dilate the pupil to its fullest extent with atropine, without any consideration as to the form of the disease or the progress it may have made. The prolonged use of atropine may induce acute granular conjunctivitis; if we observe any symptoms indicating the commencement of an attack of this kind, the instillation of atropine must be at once stopped, but we may apply the

Granular conjunctivitis from long use.

Poisonous effects of atropine.

extract of belladonna mixed with atropine over the patient's eyelids and temple. I have seen alarming symptoms of poisoning by atropine follow the application of a strong solution of this drug to the eye, but they were cases in which only a small quantity of atropine had been used, being instances of a peculiar and uncommon idiosyncrasy on the part of the patient to the poisonous influences of atropine.

Gelatine tablets.

Atropine may be conveniently applied in some instances mixed with gelatine, so as to form small tablets. A tablet thus prepared is placed on the conjunctiva of the everted eyelid; the eye may then be closed, and the lachrymal secretion dissolving the atropine, it becomes absorbed, as it would be if dropped into the eye as an aqueous solution.

Belladonna.

Extract of belladonna is a less potent remedy than atropine, and is not to be relied on for dilating the pupil in iritis. Equal parts of extract of belladonna, Indian hemp and glycerine, to which atropine has been added, form a useful mixture, which may be smeared over the affected eye to relieve ciliary neurosis.

Fomentations.

*Fomentations, Shades, &c.*—Poppy-head fomentations are often soothing to the patient, and whenever this is the case, they may be used with advantage five or six times a day; if they do not relieve the pain it is advisable to discontinue them. Hot water compresses of as high a temperature as the patient can bear them, to be changed every ten minutes, are useful in many cases of parenchymatous iritis.

Hot compresses.

Pad and bandage.

In all instances of iritis the affected eye should be shaded from the light.

Counter-irritation, in later stages.

*Counter-irritation*, in the form of blisters to the temple, is comparatively useless in the active stages of iritis, but subsequently it is beneficial, especially when the patient suffers from dimness of vision, depending on haziness of the posterior layer of the cornea.

Iridectomy;

*Iridectomy.*—Supposing the case of iritis is one which has resisted the means of treatment described in the foregoing sections, and rather grows worse, that the pupil will not dilate by atropine, and that the patient's sight is growing more and more dim, the intra-ocular tension being increased—we are no doubt justified as a last resource in performing an iridectomy. This operation

in fact holds out the best and probably only hope for the patient; nevertheless, iridectomy in cases of iritis is, be it remembered, our last hope: we have no right to fall back upon it until every other means of cure has been attempted, for it is seldom successful in cases where active changes are going on in the iris, especially if due to syphilis. Subsequently, when the inflammation has passed away, and the patient applies to us suffering from synechia, we may, as I shall presently notice, without hesitation resort to the operation of iridectomy.

only after other means have failed.

*The Treatment of Constitutional Symptoms* will consist partly in the employment of hot baths and sudorifics, but the administration of opium tends towards allaying fever of this kind, as well as relieving the troublesome vomiting occasionally met with among patients suffering from iritis. The state of the bowels must be attended to, but to administer purgatives indiscriminately, because an individual is suffering from inflammation of the iris, is a most unphilosophical proceeding, and may complicate matters by disordering the digestive organs, which have frequently nothing to do with the disease of the eye. In numerous cases of iritis, especially in a malarious country like Bengal, we shall have to resort freely to the use of quinine, arsenic, aconite, strychnine, and iron, for the cure of the disease.

Treatment of fever.

Alteratives.

Various drugs.

With regard to the use or withdrawal of stimulants and food, these are doubtless powerful agents in the treatment of disease. In a case of iritis occurring in a plethoric individual, purgatives, starvation, and in fact depleting treatment, are called for; but many cases of iritis are of an asthenic type, and require a moderate amount of stimulants, good wholesome food, and fresh air; in some cases we shall have to administer bark and ammonia, together with wine and beef-tea. It is impossible to lay down rules on these matters which shall be applicable to all cases; nothing but observation and experience can guide us to a right conclusion, and as one man's powers differ from those of another in appreciating these circumstances, so will the one differ from the other in his success in practice.

Food and stimulants with discretion.

*Management of Synechia.*—Supposing the patient's sight to be impaired by synechia, or bands of adhesion which have

Synechia.

First use atropine.

formed in the pupil, we must, in the first instance, endeavour to dilate the pupil by a persevering use of atropine; but in case the adhesions cannot thus be broken down, and provided the acute inflammatory symptoms have passed away, it will be necessary to resort to an iridectomy.

Corelysis in partial synechia.

In instances where the pupil is only partially closed, or when the synechia binds the iris down to the lens at one or more points, a portion of its margin remaining free, if atropine, after

To break down adhesions.

a persistent trial, fails to dilate the pupil and break down the bands of adhesion, it may seem advisable to perform the operation of corelysis, as recommended by Mr. Streatfeild.* For adhesions involving more than the margin of the pupil, and when the iris is completely tied down to the lens, we must unquestionably resort to iridectomy, and in my own practice I seldom, if ever, perform any other operation for the relief of synechia.

Preparatory steps.

*Corelysis.*—The steps to be taken in performing the operation of corelysis are as follows :—A solution of atropine must first be dropped into the patient's eye three or four times a day, for a week prior to the operation; we shall thus be able to discover those parts of the margin of the pupil which are still free from adhesions, by the pupil dilating at those points; and as our object is to insert a small spatula through an opening of this kind, between the lens and iris, and then carefully to break down the synechia with the instrument, so as to free the iris from the capsule, this careful study of the condition of the parts, before we attempt to operate, is very necessary.

Details of the operation.

This done, the patient is placed in the recumbent position, and chloroform having been administered, a stop-speculum is adjusted, and the surgeon, standing behind his patient, secures with a pair of fixing forceps a fold of conjunctiva close to the margin of the cornea, so as to steady the eyeball. A sufficiently large puncture is then made in the cornea, as nearly as possible opposite to the principal adhesion; a Streatfeild hooked spatula is inserted through the wound into the anterior chamber, and the blunt extremity of the instrument is passed under the margin of the pupil, and between the iris and lens (its point being care-

* *Ophthalmic Hospital Reports*, vol. ii. p. 309.

fully directed away from the latter) and far enough beneath the iris, to enable us, by a slight lateral and traction movement, to lift the iris away from the lens and break through the synechia. The hook near the extremity of the instrument is very useful, enabling us to tear through any tough bands of adhesion, which might otherwise become elongated when force is applied, and so elude our best efforts to reinstate the pupil. Corelysis.

It is necessary to be careful not to wound the capsule of the lens during this operation ; but if the patient is fully under the influence of chloroform, and if too much is not attempted at a time, it usually escapes uninjured. Those parts of the synechia only which are opposite the point of puncture in the cornea, should be broken through during one operation ; for instance, if the adhesions we propose dividing are situated on the inner side of the pupil, but if there are also others above and below the pupil, we should make our puncture in the outer part of the cornea, and passing the spatula through it, insert the point of the instrument beneath the inner margin of the pupil, breaking down the adhesions in this situation, and leaving those above and below for a future operation. For the division of these the punctures must be made in the lower and upper part of the cornea respectively. Caution as to lens. Successive operations required.

It is a point of some importance in operating, to take care that the aqueous humour be prevented from escaping till after the synechia is broken through. This may generally be managed by having a spatula just large enough to fill the puncture made in the cornea. It is impossible to lay down any precise rules as to the distance from the margin of the cornea at which the opening should be made. Our aim should be to select a spot which will most readily admit of our passing the spatula through it, in such a direction as to avoid the lens, and enable us to break through the adhesions at the greatest advantage. Further directions. Preserve aqueous.

The after-treatment is very simple. Atropine must be dropped into the eye three times a day, so as to dilate the pupil as far as possible, and the eye is to be kept closed with a pad and bandage for ten or twelve days ; we may then proceed to break throughany remaining adhesions, if the irritation caused by the former opera tion has subsided. Atropine afterwards.

Iridectomy in closed pupil.

*Iridectomy.*—As I before remarked, in cases where the pupil is closed by false membranes, or its margin is extensively bound down to the lens by synechia, should we even desire to do so, it is impossible to perform the operation of corelysis, and it becomes necessary to resort to iridectomy. If this proceeding is neglected in cases of this description, the communication between the chambers of the eye being closed, an accumulation of fluid takes place in the posterior chamber, which forces the iris forwards, and by traction on its outer attachments, the iris drags on the tissues forming the canal of Schlemm, which, together with Fontana's spaces, become blocked, and so may perhaps induce glaucoma. In these cases of closed pupil, the outer part of the iris is pressed forwards towards the cornea by the aqueous fluid behind it; but its pupillary border, being bound down to the lens, cannot be thrust forward in this way, and appears, as it were, in a pit, the iris being funnel-shaped.

Prevents posterior tension.

Numerous proceedings have been advocated for the relief of this state of things, among which operations for the formation of an artificial pupil hold a prominent place; but it may now be safely affirmed that an iridectomy is the most satisfactory practice. Iridectomy embraces all the advantages of an artificial pupil, and, in addition, has many of its own to offer, not the least of which is, that it tends greatly to lessen the chances of recurrent iritis and glaucoma by relieving the traction exercised by the iris on the canal of Schlemm. It may therefore be stated generally, that in instances of synechia, or closed pupil, which cannot be broken through by the aid of mydriatics we must resort to iridectomy, excising a portion of the lower and inner, or the lower and outer section of the iris.

Iridectomy restores sight.

Prevents recurrent iritis.

Should not be delayed.

In this class of cases the operation should be performed as soon as the active symptoms of iritis have passed away, seldom before; it is not necessary, however, to wait till all pain and irritation in the eye have subsided; for these symptoms are perhaps kept up by the synechia, and if we wait till the irritation has entirely passed away, it may be that the integrity of the deeper tissues of the eye will have been destroyed in the meantime.

Indications for and against.

The amount of sight a patient may possess is hardly a safe

guide as to the necessity for iridectomy; the central portion of the pupil may be clear, and yet no communication exist between the chambers of the eye; under these circumstances, although the patient may see tolerably well, we must not hesitate to perform iridectomy. On the other hand, if the patient has no perception of light, it is almost useless operating with an idea of improving his sight; for it is more than probable that detachment, or other destructive changes in the retina, which iridectomy cannot possibly influence, have taken place. Iridectomy. Amount of sight;

In cases where the iris bulges prominently forwards towards the cornea, indicating the collection of a considerable quantity of fluid in the posterior chamber, iridectomy is less likely to be successful than if the iris is in its normal position. These chances are still further reduced if we can make out a central opacity in the capsule of the lens, a condition often indicative of detachment of the retina.* Bulging iris; Capsular opacity.

There may be some little difficulty in removing a portion of the iris, in cases where it is swollen from the pressure of the products of inflammation, or when it has undergone atrophy. Under these circumstances straight, pupillary forceps, with sharp teeth, may be used, which, instead of following the ordinary direction, should be applied to the iris somewhat perpendicularly. Graefe's forceps.

TRAUMATIC IRITIS.—The general principles upon which we should conduct the treatment of a case of traumatic iritis differ in no respect from those already laid down for our guidance in other forms of inflammation of the iris; but we frequently meet with complications in these cases, arising from the lens having been injured, together with the iris. Under these circumstances, the capsule is often perforated, and the lens substance swells, becomes opaque, and by pressing upon the iris, keeps up violent irritation and inflammation of the part. TRAUMATIC IRITIS. Lens often wounded.

Whenever a case of this kind presents itself to our notice, soon after the accident, a considerable portion of the iris must be removed at once. The patient should be placed under the Excise the iris and remove the lens.

* Professor A. von Graefe "On Iridectomy," p. 266. (New Sydenham Society.)

influence of chloroform, and a Weiss's stop-speculum having been adjusted, the surgeon should make an opening through the upper portion of the corneo-scleral junction as if for iridectomy; about a fourth of the iris should be excised, the lens had better not be removed, it will in the course of time become absorbed.

Delay dangerous.

The success of iridectomy, in cases such as I have above described, depends upon the promptness with which it is undertaken. If the surgeon attempts palliatives, such as leeches and the like remedies, in the hope of reducing the inflammation, the chances are that his opportunity will slip away, and general inflammation, and perhaps abscess of the globe, will supervene; whereas, if iridectomy is performed immediately after the accident the patient will be saved much suffering, and with the aid of spectacles, may possibly regain a fair amount of vision. On the other hand, if, after an accident such as I have referred to, some days or weeks pass before we see the patient, and the globe of the eye is tender, the lens opaque and pressing the iris forwards against the cornea, it is necessary to excise the affected eyeball as soon as possible.

A foreign body in the iris.

Occasionally a chip of steel, or some such foreign body, gets lodged in the iris, causing violent inflammation. Supposing the lens has not been wounded, we may succeed in extracting the foreign body with a pair of cannula forceps; or, I do not hesitate to make a free opening in the cornea, and introduce a pair of iridectomy or other small forceps, to secure and remove the offending substance. Should the lens be also involved, a traumatic cataract being present, it is advisable to perform an iridectomy, including the foreign body in the portion of the iris excised, and then extract the opaque lens as above described.

to be removed.

## WOUNDS AND INJURIES OF THE IRIS.

Incised Wounds.

Incised Wounds.—I have given an account of the symptoms and treatment of prolapse of the iris following perforation of the cornea; it is consequently unnecessary for me to return to the subject.

A simple incised wound of the iris is a rare accident, for in

the majority of instances the lens is involved in the injury, and a traumatic cataract results. Incised wounds of the iris are always attended with more or less hæmorrhage into the anterior chamber, and temporary impairment of vision. Inflammation seldom follows clean incisions of the iris, as for instance those made in the formation of an artificial pupil, but the edges of the wound gape open, leaving a space through which the rays of light reach the retina. Occasionally the lips of an incised wound unite, a blood-clot forming between them, its fibrine becoming organized, drawing the edges of the wound together; but in instances of this kind the contractile power of the iris has commonly been impaired by previous inflammation, which prevents the wound from gaping open as it does in the healthy tissue.

Rarely simple.

Not followed by inflammation.

Apt to gape.

After an incised wound, the eye must be kept at rest until the blood in the anterior chamber has become absorbed. We can hardly venture on a prognosis till this has occurred.

FOREIGN BODIES sometimes become lodged in the iris without wounding the lens; they may be best seen on examining the eye by the oblique method of illumination. Having discovered the situation of the offending particle, the cornea should be punctured, and a pair of cannula forceps passed into the anterior chamber; the foreign body being seized, it may usually be withdrawn from the eye without difficulty. The pupil should subsequently be kept fully dilated, and the eye at perfect rest, till all signs of irritation have subsided.

FOREIGN BODY IN IRIS.

Should be removed,

It will generally be necessary to administer chloroform, in order that we may command the eye during the operation, and we should never delay the removal of the foreign body for one hour longer than is necessary. If the eye is already inflamed, this will be an additional reason for immediate interference, rather than an indication for delaying the operation. Should there be any difficulty in seizing the foreign body, it is advisable to make a larger opening in the cornea, and to excise a portion of the iris, removing it from the eye together with the foreign body.

under chloroform, without delay.

Instances have been recorded, and I have myself met with them, in which particles of steel and similar substances have

Rarely becomes encysted.

become encysted in the iris, and yet given rise to no irritation; but cases of this description are so rare, and destructive inflammation of the globe of the eye so constant a result of the presence of a foreign body in the iris, that we are not justified in trusting to Nature in such cases.

Dilate the pupil in all cases.

In wounds of the iris, whether incised, or resulting from the presence of a foreign body in the eye, it is advisable to dilate the pupil with atropine, before venturing on a prognosis, or any particular line of treatment; because the lens may have been wounded, and the point of injury, which is perhaps covered by the iris, may not be apparent until the pupil is fully dilated. A complication of this kind would, of course, materially affect the prognosis, a traumatic cataract in all probability resulting from the injury to the lens.

DETACHMENT OF IRIS

DETACHMENT OF THE IRIS from its ciliary border may be complete—that is, the whole of the iris may be detached; or a mere slit may exist in its ciliary border. An accident of this kind usually occurs from an injury, as for instance from

from a blow.

a blow with the fist upon the eye. In these cases the nature of the accident may not be detected in the first instance, on account of the effusion of blood which takes place into the

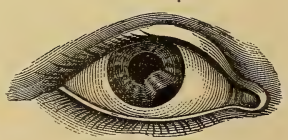
Extent of injury concealed by blood.

anterior chamber. It will be necessary, therefore, to be guarded in our prognosis, as it is impossible to determine the extent or nature of the injury, or if it be complicated with detachment of the retina, until the effused blood has become absorbed.

If a portion of the iris has been detached from its ciliary border, as soon as the aqueous becomes clear we shall notice a false pupil, varying in size according to the extent of the detachment of the iris (*vide* Fig. 40). The part of the pupil corresponding to the detached border of the iris is uninfluenced by the stimulus of light, its nerves and contractile tissue having been torn through at the point of separation of the iris from its ciliary border. In instances where the line of separation is narrow, it often requires a very careful examination of the parts

False pupil formed.

FIG. 40.



to detect the lesion, and to account for the otherwise inexplicable irregularity and inaction of a portion of the pupil.

A patient's sight is usually somewhat impaired by an accident of this kind, the irregularity of the pupil interfering with perfect vision; and if the rent in its ciliary border is a large one, a number of extraneous rays of light enter by the artificial pupil, and falling on the retina produce considerable confusion in the visual image. In a remarkable instance the whole of the iris was removed by Von Graefe; and what is most curious is the fact recorded by Mr. Soelberg Wells, that the patient's vision was as perfect without his iris as with it. Mr. Wells remarks of this case*—"The field of vision of the right eye, in which the iris had been extracted, is normal; the sight most excellent, so that the patient can count fingers at the distance of 120—140 feet, and can read the smallest print. He possesses great power over the dispersed rays, and does not find himself in the least dazzled by the light. And lastly, to crown all, the accommodative power of this eye, with its *irideremia totalis*, is almost ($\frac{1}{6}$—$\frac{1}{7}$)."

Sight impaired.

Case of total loss of iris.

Vision unimpaired.

We can do little in the way of treatment in cases of detachment of the iris, beyond keeping the eye at rest, for the accident is irremediable, so far as the reparation of the injury is concerned.

Treatment nil.

LACERATION OF THE PUPIL.—A few cases of laceration of the pupillary margin of the iris have been recorded, following blows, and unaccompanied by either a wound or external injury to the globe of the eye. It is difficult to conceive how an accident of this kind can take place from concussion, nevertheless a rent of the pupillary border, and in other cases rupture of the fibres of the iris, have been known to follow it. As the opening in the iris is nearer the axis of vision than in detachment of its ciliary border, the defect of sight is greater, because the rays of light fall on the retina nearer the macula lutea.

LACERATION OF THE PUPIL.

Visual disorder greater.

* *Ophthalmic Hospital Reports*, vol. ii. p. 199.

## TUMOURS OF THE IRIS.

Cysts of Iris

CYSTIC TUMOURS OF THE IRIS are rare, and when met with, as a general rule, follow an injury to the eye, and the formation of a clot of blood in the substance of the iris; in fact they are small hæmatomas; but independently of accidents, cystic tumours do occasionally grow from the iris. They usually appear as a small transparent vesicle springing from a broadish base attached to the anterior surface of the iris. Mr. Hulke remarks:—"An examination of all the cases which I have been able to collect shows: I. That cysts, in relation with the iris projecting into the anterior chamber, originate in two situations—(1) in the iris; and (2) in connexion with the ciliary processes. The first lie between the uveal and the muscular stratum of the iris, and are distinguished by the presence of muscular fibres upon their anterior wall; the second lie behind the iris, and bear the uveal as well as muscular strata on their front. II. It also shows that these cysts are of more than one kind; that there are (1) delicate membranous cysts, with an epithelial lining and clear limpid contents; (2) thick-walled cysts, with opaque thicker contents (whether these are genetically distinct from 1 we are not yet in a position to determine, but it seems probable that they are so); (3) solid cystic collections of epithelium, wens or dermoid cysts; (4) cysts formed by deliquescence in myxomata. III. As regards treatment, puncture, simple or combined with laceration, is so generally unsuccessful that excision is always preferable. It is evident that the chances of success will be proportionate to the completeness of the excision, and the practicability of this will vary with the size of the cyst and the extent of its connexions, and with its position in or behind the iris." It is clearly advisable, therefore, to excise the cyst, together with the segment of the iris from which it springs, as speedily as possible, otherwise the abnormal growth may excite dangerous irido-choroiditis, or sympathetic disease in the other eye.

often follow a clot of blood.

Varieties.

Should be excised.

Condylomata.

CONDYLOMATA may often be seen springing from the iris in cases of parenchymatous inflammation, and I described their appearance when speaking of that affection. Should the

condyloma increase to any considerable size it may, by coming in contact with the cornea, excite keratitis, which no treatment will relieve until the cause of the irritation has been removed.

The syphilitic history of the case would lead us to a correct diagnosis of the disease; and its treatment is comprised in that already recommended in parenchymatous iritis. There is only one condition of the parts, that I am aware of, which could be mistaken for the disease in question, and that is the presence of neoplastic growths, such as are sometimes observed on the iris in those who suffer from leprosy; but the appearance of the patient, under these circumstance, would at once correct an erroneous impression as to the nature of the disease. It is possible, of course, that a leprous patient may contract syphilis, and therefore suffer from condylomata of the iris, but such cases are rarely met with.

Generally syphilitic; sometimes leprous.

MELANOMA AND SARCOMATOUS TUMOURS of the iris have been met with, but cases of this kind are of rare occurrence.

CYSTICERCI OF THE IRIS are occasionally met with; Fig. 41 is a copy of a drawing from one made by Mr. P. Teale, showing the position of a cysticercus attached to the iris, which he removed, together with a portion of the iris, by an iridectomy. The eye, prior to the operation, presented the following appearances:—On the surface of the lower part of the iris was seen an opaque body, constricted in the middle, and rather larger than a hemp seed, which was evidently causing some distress to the eye. The conjunctiva was slightly injected; the cornea was bright, but dotted on its posterior surface with minute spots, as in corneo-iritis; the iris was active, except at the situation of the white body, near which it was adherent to the capsule of the lens; tension normal. Reading No. 16, Jaeger.*

Cysticerci of Iris.

FIG. 41.

Appearance.

In instances of this kind the plan of treatment adopted by

* *Ophthalmic Hospital Reports*, vol. v. p. 230.

Removal by iridectomy.

Mr. Teale possesses considerable advantages over any other, the cysticercus being removed from the eye, together with the portion of the iris to which it was attached, by an iridectomy.

LEPROUS AFFECTIONS OF THE IRIS are extremely common among persons suffering from leprosy; in fact, in cases of this disease of long standing, it is rare to find the iris and cornea healthy. I have observed that, as a general rule, the cornea is affected before the iris in these cases, and that plastic iritis is more common than the parenchymatous form of disease. Leprous tubers form on the iris as they do on the cornea, and especially on the conjunctiva (*vide* p. 240).

## FUNCTIONAL DISEASES OF THE IRIS.

MYDRIASIS.

MYDRIASIS is an abnormal dilatation of the pupil, occurring independently of disease of the deeper structures of the eye; so that, although the pupil does not contract on exposure to light,

Simple dilatation of pupil.

and the patient suffers from impairment of vision, in consequence of the excess of light admitted into the eye, still this defect is remedied by placing a diaphragm, with a small hole drilled through it, in front of the eye. The outer rays of the cone of light impinging on the retina being cut off, the defective vision is in great part corrected; and the patient, while looking through the hole in the diaphragm, sees well. This contrivance will not, of course, overcome defects due to loss of accommodation, depending on causes similar to those which induce the mydriasis. The same result may be attained by causing the pupil to contract by the application of eserine to the eye. The above definition of *mydriasis*, therefore, excludes all cases of dilatation of the pupil depending on deep-seated disease of the eye.

Causes:

Mydriasis may be confined to one eye, or both eyes may be affected. The cause of the dilatation of the pupil may be the

paralysis of third nerve.

suspension of the functions of the third nerve, the circular fibres of the iris being thus paralyzed, for when this nerve is divided the pupil remains dilated. The same effect may be induced by

Irritation of sympathetic.

irritation of the cervical branches of the sympathetic, which are

distributed to the dilatator pupillæ: this muscle being thrown into action, the pupil dilates.*

*The Treatment* must evidently depend on the nature of the disease. In some few instances it appears to arise from reflex action, excited by the presence of a foreign body on the cornea or conjunctiva; or it may be that some more distant branch of the sentient nerve is in the first instance affected, the irritation being conveyed by reflex action through the oculo-motor nerve, and thereby destroying the contractile power of the circular fibres of the iris. In these cases our first care should obviously be to remove, if possible, the cause of the irritation. *Treatment.* Remove the cause of irritation.

If the mydriasis appears to depend on defective action of the third nerve, Faradization may be useful; the action of the galvanic current, however, should never be continued for more than a few seconds at a time,† and if the pupil does not contract speedily under its influence, we can expect but little benefit from continuing this treatment. Should the patient have suffered from syphilis, the case must be treated upon the principles generally applicable under such circumstances. Faradization.

If the dilatation of the pupil results from irritation going on in the intestinal canal, whether excited by worms, or any other cause, and propagated through the sympathetic to the radiating fibres of the iris, we must endeavour to remove the source of irritation by anthelmintics in one case, and by a blue pill and black draught in another. From my own experience, I am inclined to believe that some such source of irritation is the most frequent cause of mydriasis; and these remote remedies may do more to overcome the dilatation of the pupil than anything else. The affection may sometimes be relieved in a marked way by the instillation of a solution of eserine, but can hardly be cured unless by appropriate treatment directed towards the restoration of the functions of the stomach, liver, or any other organ which may appear to be at fault. Anthelmintics and purgatives.

MYOSIS is precisely the opposite condition to mydriasis; the MYOSIS.

* J. Bell on the Pathology of certain Forms of Dilated Pupil: *Edin. Med. Journal*, No. X. p. 917.

† *Vide* page 100.

pupil being abnormally contracted, and failing to dilate as it should do when the patient is placed in a dark room, or after sunset. The pupil will, however, expand under the influence of mydriatics; and it may then be noticed that it is perfectly regular, and hence its inability to dilate is clearly not dependent on synechia.

Pupil contracted,

From excitation of the third nerve.

The contraction of the pupil under ordinary circumstances is a reflex action, excited by the stimulus of light falling on the retina, and being propagated to the oculo-motor nerve, so that the circular fibres of the iris contract and close the pupil. If only a small quantity of light enters the eye, as is the case after sunset, its action on the retina is slight; and consequently, the excitation of the third nerve is proportionably less than in daylight, the pupil remaining semi-dilated. Division of the sympathetic in the neck is likewise followed by contraction of the pupil, the *dilatator pupillæ* being paralyzed; lesions of the spinal cord affecting the sympathetic may thus produce myosis; so that, in instances of myosis, we must consider all the circumstances of the case by the light of our knowledge of the physiology and pathology of the third and sympathetic nerves. This condition is occasionally caused by long-continued work upon minute objects, as for instance in watchmakers, the sphincter muscle of the iris acquiring a preponderating power over the dilatator.

Or paralysis of sympathetic.

Mistaken for night blindness.

Cases of myosis are sometimes mistaken for hemeralopia (night blindness), in that the patient complains principally of impairment of vision coming on after sunset, which evidently depends on an insufficiency of light reaching the retina through the contracted pupil to produce distinct vision. The patient has no pain in the eye, and his sight is good during the day. The case very much resembles one of hemeralopia, with this difference, however, that in hemeralopia the pupil acts freely, the disease essentially consisting in a temporary loss of power in the retina, arising from over-stimulation, or from anæmia of its nervous elements; the latter being by far the most common cause of night blindness.

We know at present so little about the functions of the sympathetic, that it is imposible to understand why, in some cases of

habitual constipation, or of dyspepsia, myosis occurs. We suppose that it arises from some disturbance of the sympathetic, propagated to the branches supplying the iris—a very vague explanation it is true, but the best we can give of the matter. In cases of this kind our wisest plan of treatment is to correct and improve the state of the digestive organs as far as we can. Dyspepsia a cause of myosis.

Irritation of the oculo-motor nerve, arising from meningitis, or a clot of blood, or other affection of the brain substance from which the nerve originates, may induce contraction of the pupil; but, under these circumstances, the myosis is a very unimportant matter in comparison with the primary disease. The contracted state of the pupils in cases of tabes dorsalis is frequently seen among out-patients at our hospitals. Affection of the brain.

Artificial mydriasis and myosis may be induced respectively by the action of atropine and Calabar bean, as well as by some other drugs.

TREMULOUS IRIS (iridodonesis) is very seldom seen unless the lens has been removed. As the iris rests on the crystalline, we can readily understand that when the lens is taken away, the iris having lost its support, hangs like a loose curtain in the anterior chamber, and consequently has a tremulous movement imparted to it when the eye is turned from one side to the other. The same result may occur from an excess of aqueous in the posterior chamber forcing the lens backwards and the iris forwards (hydro-ophthalmia)—a condition but rarely met with. If the vitreous is in a fluid condition, the lens may sink deeply into it, receding from the iris, and iridodonesis result. Under these circumstances, the ophthalmoscope will reveal the nature of the disease and the cause of the tremulous movement of the iris. TREMULOUS IRIS from loss of lens. Excess of aqueous. Fluid vitreous.

## ARTIFICIAL PUPIL.

THE OPERATIONS usually employed for the formation of an artificial pupil are two in number. 1st. With a broad needle and Tyrrell's hook. 2nd. Iridectomy. ARTIFICIAL PUPIL. Various operations.

Before describing the method of performing these operations, I would observe, that the chief danger we have to avoid in

Caution as to the lens.

practising them is not to wound the lens, and thereby cause a traumatic cataract. Ordinary caution, especially if our patient is under the influence of chloroform, will enable us to steer clear of this danger ; and it is almost impossible to lay down any rules which would be of assistance in the matter. A gentle hand and steady eye, with a thorough knowledge of the anatomy of the parts, are the principal requirements in these as in other operations on the eye.

1. Excision of Iris.

Tyrrell's Operation for Artificial Pupil—Chloroform having been administered, the patient being laid on his back upon a couch in front of a good light, and a stop-speculum adjusted, the surgeon stands in the position most convenient to effect

Operation with Tyrrell's hook.

the work he has to perform, and secures the eyeball by seizing a fold of the conjunctiva, near the margin of the cornea, with a pair of toothed forceps. He then passes a broad needle through the margin of the cornea, at a spot nearest to the point at which he proposes excising the iris. A Tyrrell's blunt hook is to be inserted sideways through the opening in the cornea, and passed onwards until its hooked extremity reaches the margin of the pupil, when it is to be turned downwards, so as to hook

Withdraw and excise a fold of iris.

over the pupillary margin of the iris. The instrument is then to be carefully withdrawn from the eye, being again partly rotated, and dragging with it a small fold of the iris. Immediately this fold is drawn out beyond the wound in the cornea, an assistant should snip it off, close to the edges of the wound, with a pair of curved scissors ; the speculum is then to be removed, and the eye kept closed with a pad and bandage for a few days.

Modification in corneal opacity.

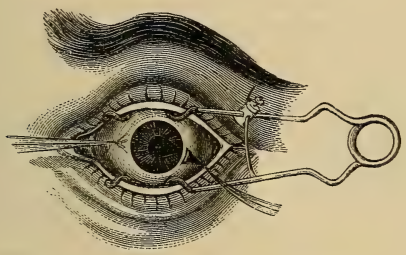
If an extensive and deep opacity of the cornea exists immediately in the axis of vision, preventing our seeing the edge of the pupil, although it may have been dilated with atropine, it it evident that we cannot perform the operation above described. It would be a dangerous proceeding to grope about with the blunt hook in the anterior chamber, in the hope of seizing the pupillary margin of the iris, which we cannot see through the opaque cornea. Under these circumstances a modification of Tyrrell's operation is rendered necessary.

In place of passing a hook into the anterior chamber, it will

be requisite to make the opening in the cornea sufficiently large to allow of a pair of cannula or iridectomy forceps being introduced into the eye. A fold of the iris, as near as possible to its pupillary margin, is to be seized, and having been withdrawn through the wound, is to be snipped off close to the cornea by an assistant (Fig. 42). Care must be taken that the iris

Operation with forceps.

FIG. 42.



is, if practicable, excised from its pupillary margin outwards, and that no tags of it are allowed to remain in the wound.

2. IRIDECTOMY.—The instruments required for this operation will be a stop-speculum, to keep the eyelids apart; a pair of fixing forceps, to steady the eyeball with; a broad lance-shaped knife, either straight or bent according to the direction in which we propose making the iridectomy; a pair of iris forceps; and lastly, curved scissors. Dr. Wecker's iris scissors are useful in this operation. The patient having been placed in the recumbent position, it is, as a general rule, advisable to get him fully under the influence of ether; the stop-speculum is then to be adjusted. The surgeon, either in front or behind the patient, standing or sitting as he may find it most convenient, seizes a fold of the conjunctiva, opposite the intended point of puncture, with a pair of fixing forceps, so as to steady the globe of the eye. He then thrusts the lance-shaped iridectomy knife through the sclero-corneal junction, at a point from $\frac{1}{2}$ to $1\frac{1}{2}$ lines behind the margin of the cornea, and thrusting the blade of the instrument steadily onwards, close in front of the iris, an opening about a quarter of an inch long is made in the sclerotic. The

2. IRIDECTOMY. Operation.

Incision in sclerotic.

knife is then to be slowly withdrawn, so that there is no sudden rush of aqueous from the eye. If the anterior chamber is very shallow, the incision may best be made with a narrow-bladed cataract knife; there is less risk of wounding the lens than with a lance-shaped knife.

The surgeon, still fixing the globe of the eye with one hand, takes a pair of iridectomy forceps in the other; and if the iris does not protrude through the wound, he inserts the points of the forceps (closed) through the wound in the sclerotic, seizes a fold of the iris about midway between its ciliary and pupillary borders, and drawing the fold of iris out through the wound, an assistant cuts off the requisite amount of iris with a pair of scissors, quite close up to the edges of the wound in the cornea. In many cases of glaucoma, after the opening has been made in the cornea, the iris protrudes through the edges of the wound: this is an advantage, for it enables us to seize a fold of the iris without inserting the forceps into the anterior chamber.

Fold of iris withdrawn and divided.

The fold of iris may be excised as above, or it may be cut off by either of the following modifications introduced by Mr. Bowman.* The iris is brought outside the chamber as above described, and divided with small scissors, on one side of the forceps, from the pupillary to the ciliary border, the forceps pulling it gently at the same time, so as to ensure complete division of the iris. The end of the iris held by the forceps is then torn from the ciliary attachment as far as the angle of the incision, and even dragged upon a little, so as to detach it beyond the angle, and divided with the scissors quite close to the angle. The cut end of the iris retreats within the chamber; the opposite side of the prolapsed part is then seized and dealt with in the same manner. But however the iris is excised, great care must be taken that none of it is left between the lips of the wound, lest the healing process be imperfect, and subsequent irritation occur in the eye.

Bowman's method.

This proceeding is shown in Fig. 43; *a*, the prolapse, divided into two portions at *b*. The lower portion is to be drawn, in the direction of *c*, to the lower angle of the incision, and snipped off.

* *British Medical Journal*, 1862, vol. ii. p. 382.

The upper portion is then to be drawn in the direction of *d*, and also divided.

Instead of dividing it into two portions, the prolapse may be drawn to one angle of the incision, and partly divided close up to the angle; the other portion, being then gently torn from its ciliary insertion (slight snips with the scissors aiding in the division), and drawn to the opposite angle, is there to be completely cut off. This is illustrated in Fig. 44; *a*, the prolapse A second method;

FIG. 43.

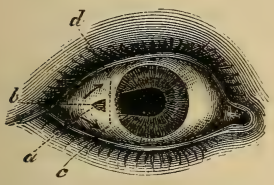
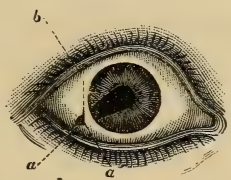


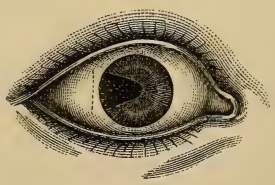

FIG. 44.




drawn down to the lower angle $a'$ of the incision, where the inferior portion is to be divided, and the other drawn up in the direction of *b*, to the upper angle of the incision.

The latter proceeding is perhaps to be preferred if there is much bleeding, for then it is not always easy to find the uncut portion, more particularly if it has slipped back between the lips of the wound. Either method will yield an excellent artificial pupil. The iris will be torn away quite up to its ciliary attachment, and the pupil will consequently reach quite to the periphery (Fig. 45).

FIG. 45.



If there is any hæmorrhage into the anterior chamber the fluid-blood should be permitted to escape before coagulation. To effect this object a small curette should be inserted between the lips of the wound, slight pressure being at the, same time made upon the eyeball with the fixation forceps, so as to facilitate the escape of the blood. The curette should not be inserted into

when preferable.

the anterior chamber. If the blood does not flow off readily, it should not be forced out, but be permitted to remain, for it will soon be absorbed, particularly if a compressive bandage is applied.*

After-treatment.

The excision of the iris having been completed, the stop-speculum is to be removed, and the eye kept closed with a pad and bandage. If the patient suffers much pain subsequently to the operation, a few doses of morphia may be administered, but this is seldom necessary.

Cautions.

1. Let the opening in sclerotic be free.

In performing the operation of iridectomy, the chief points to attend to are,—1st, to make a free opening into the anterior chamber. With a wound less than a quarter of an inch long it is almost impossible to complete the operation satisfactorily. A larger opening in the sclerotic can do no possible harm; the wound will close in twenty-four hours; there is no fear of prolapse of the iris; and the more frequently I operate, the more convinced I am that a free opening is most essential to the success of iridectomy.

2. Be careful of lens and cornea.

2nd. Be careful to keep the point of the knife midway between the iris and cornea. By attending to this rule, both the lens and cornea will escape injury.

3. Detach the iris.

3rd. It is necessary that the ciliary attachment of the iris should, if practicable, be divided. The edges of the wound must be carefully freed from any portion of the iris; if tags of it are left between them, a troublesome fistula of the sclerotic may form, or continued irritation of the iris and sympathetic irritation in the other eye established. Dr. Johnson lately showed me a beautiful specimen illustrating this point. After an iridectomy the eye became glaucomatous, and being a source of irritation was removed. A section through the line of incision showed that a tag of iris had become engaged in the cicatrix of the wound made at the time of the operation; this tag by traction on the attachments of the iris had obliterated the canal of Schlemm, and probably induced glaucoma.

4. Let alone any blood.

4th. Do not be over-anxious to remove the blood from the

* J. Soelberg Wells "On Glaucoma and its Cure by Iridectomy," p. 79. London, 1864.

anterior chamber after the operation with a scoop; it is speedily absorbed, and in the meantime can do no great harm.

With regard to the position of the opening to be made in the iris, other circumstances being favourable, the superior section of the iris should be removed, as the upper lid covers the part to a considerable extent, and in this way lessens the blurring caused by the excessive amount of light which would otherwise reach the retina. In instances of ulceration or opacity of the cornea, the position of the iridectomy must be adapted to the circumstances of the case. An upper opening preferable.

The knife employed in making the opening through the upper and inner part of the sclerotic should have the blade bent at an obtuse angle with the shaft; an instrument of this kind facilitates the operation. But in making the lower and outer section I prefer such a knife as one ordinarily uses in cases of linear extraction. Instruments.

The after-treatment consists in keeping a pad and bandage over the eye, and the patient should be confined to his bed for a few days. The wound in the sclerotic heals in three or four days. Nevertheless, it frequently happens, that a few days after the operation of iridectomy the tension of the eyeball increases, and continues in this condition for some time, when the intra-ocular pressure diminishes, but the full advantages of the operation are not perfected, until it may be six weeks, or even two months' time after it has been performed. After-treatment.

Iridectomy is especially called for in glaucoma, acute serous choroiditis, irido-choroiditis, rapidly advancing or intractable ulcers of the cornea, in occlusion of the pupil, and in combination with other operative means for the removal of the lens. When called for.

CIRCUMSTANCES REQUIRING AN ARTIFICIAL PUPIL.—The end we have in view is to make an opening for rays of light to reach the retina when they are otherwise prevented doing so by a central opacity of the cornea, a closed pupil, or other obstruction. ARTIFICIAL PUPIL WHEN REQUIRED.

The conditions necessary, therefore, for the successful performance of this operation, are—First, that a portion of the cornea be transparent, and its curvature not greatly altered, Conditions necessary for success-

otherwise the refraction of the rays of light which reach the retina may be so much deranged as to lead to serious impairment of vision. Secondly, if the iris is completely adherent to the lens or cornea, we can hardly expect to form an artificial pupil. Lastly, the lens and internal membranes of the eye must be tolerably healthy, otherwise making an opening in the iris will scarcely improve the patient's sight.

Amount of sight tested.

We may generally form a tolerably accurate judgment as to the state of the retina under these circumstances by holding a bright lamp in front of the affected eye. The degree in which the patient is conscious of the illumination will be our guide to the amount of retinal sensibility; if he cannot distinguish the existence of the flame it will be useless operating.

Tension of eye.

The tension of the eyeball will also afford us valuable information as to the condition of the deeper structures. In many instances the globe will be found soft and hopelessly atrophied; in other cases its tension may be increased from intra-ocular pressure: in either case, our chance of success by means of an artificial pupil will be lessened.

1. Choice of operation in central opacity.

1. In cases of central opacity of the cornea, whether complicated with staphyloma or not, but obstructing the passage of light to the retina, it is well in the first place to apply atropine to the eye, and thus discover to what extent the pupil is dilatable.

Iridesis, if pupil dilatable.

If the pupil expands freely, it will be advisable to make an artificial pupil downwards and inwards. Should the cornea be opaque in this position, we must make the artificial pupil downwards and outwards; and failing this, behind the most healthy part of the cornea.

But if, in central opacity of the cornea, we find the pupil will not dilate, the iris being firmly tied down to the capsule of the lens or to the cornea, it will be necessary to employ the forceps in order to withdraw a fold of iris from the eye, which must must then be snipped off by an assistant.

Size of new pupil.

With regard to the dimensions of an artificial pupil, this will depend much on the condition of the cornea; but as a general rule, we may endeavour to imitate Nature in this respect, making our opening through the iris about the size of the healthy semi-dilated pupil.

2. It may, however, be necessary to make an artificial opening through the iris under other circumstances than those of opacity of the cornea; as, for instance, after injuries or wounds of the cornea, where a prolapse of the iris has taken place into the wound and the pupil has been drawn into the cicatrix. Such an accident sometimes occurs after extraction of the lens. In cases of this kind, it will be well to use the forceps, excising a fold of the iris as nearly as possible in the axis of vision. To prevent any dragging on the iris during the operation, the opening in the cornea must be made well forward, in fact, as near as possible to the position of the artificial pupil, without being actually in front of it.

2. In closed pupil from prolapse.

excise a portion of iris.

Position of incision.

3. Again, in cases where the pupil has been closed by neoplastic growths, the result of iritis, it may be necessary to open a passage for the rays of light to the retina by means of an iridectomy, which may also prevent the occurrence of glaucomatous changes in the eye.*

3. Inclosure from synechia.

4. Lastly, an artificial pupil may be necessary in certain forms of zonular cataract, characterized by central opacity of the lens, its margin being transparent. A cataract of this kind has often but little tendency to extend, and therefore it may be unnecessary to remove the lens; but the pupil may be advantageously displaced towards the transparent margin of the lens.

4. In zonular cataract.

We are often consulted by patients having one sound eye, and the other damaged in such a way as to render an artificial pupil necessary for the perfection of vision; and the question arises as to how far it is advisable to operate on the diseased eye, when the patient sees perfectly well with the other one.

Should a pupil be made when one eye is sound?

As a rule, it is well to operate on the diseased eye, for in the first place we may by this means restore binocular vision, and can certainly enlarge the field of view by bringing both eyes into play. It will be necessary, before operating in cases of this kind, to ascertain the amount of vision the patient possesses with the diseased eye; it is useless interfering if it has no perception of light.

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* *Ophthalmic Hospital Reports*, vol. i. p. 207.

## Cyclitis.

Cyclitis, From the similarity which exists between the structures of the iris and the ciliary body, and their direct connection with one another, it is evident that inflammation of the iris is likely to spread backwards to the ciliary body, or it may commence in the latter structure and extend to the iris. When cyclitis has been in existence for some time it is difficult to ascertain whether it began in the iris or the ciliary body.

Pathology of Plastic Cyclitis. Plastic Cyclitis.—This is the most common form of cyclitis, and, as a rule, the iris or other structures of the eyeball are also involved in the inflammatory process. In the early stages of plastic cyclitis we find that, as in similar affection of the iris, the bloodvessels are hyperæmic and the surrounding tissue infiltrated with cell-elements from which neo-plastic formations grow. In some cases, the leucocytes and other cells resulting from the engorged state of the vessels pass forwards, not only to the iris, but fill the posterior chamber, and unless speedily absorbed, extensive synechiæ form, leading to the obliteration of the posterior chamber. Further than this, the exudation, or new cell-formation, the result of cyclitis, may extend over the posterior surface of the lens, and in fact traverse the whole of the eyeball. In cases of this kind the retina frequently becomes affected, sending out tubular excrescences from its uveal layer into the cyclitic membrane ; these processes have been mistaken for bloodvessels. At a subsequent stage of the disease, lime, and even osseous tissue, is sometimes found in the new growth. But prior to such changes the neoplastic tissues will, as they become organized, contract, and in doing so they obliterate the vessels of the ciliary body, and lead to cataract from imperfect nutrition of the lens. From the same cause, detachment of the ciliary body, the choroid or retina may occur, and too frequently the eye becomes atrophied.

*Symptoms :* *Symptoms.*—In cases of plastic cyclitis there is congestion of both the deep and superficial vessels surrounding the cornea. The patient often suffers from acute pain in the eye and tenderness on pressure over the region of the ciliary body ; the vitreous is quickly and extensively involved. The iris is dis-

coloured, and pressed forwards towards the cornea, so that the anterior chamber becomes narrow from before backwards; and as I mentioned when speaking of iritis, these growths on the iris are apt to degenerate into pus: so, in the form of cyclitis now under consideration, an hypopion is from time to time noticed in the patient's eye, caused by the degeneration of the exudation derived from the ciliary body. Lastly, the iris in instances of this disease is frequently closely bound down to the capsule of the lens by means of the organized materials. As a result of the diseased action going on in the ciliary body and choroid, not only is the episcleral zone of vessels engorged, but numerous large and tortuous bloodvessels may be seen on the surface of the iris. The patient's sight is greatly impaired, and unless the disease be checked is gradually lost.

Pain on pressure.

Hypopion.

Closed pupil.

Iris vascular.

*Causes.*—Excluding cases of "sympathetic cyclitis," the most frequent cause of plastic cyclitis is syphilis; but the disease may arise from an injury to the eye, such as an incised wound over the ciliary region, the lodgment of a foreign body in the eye, or the forcible removal of a piece of opaque lens capsule, if during the operation the ciliary processes are dragged upon by the surgeon.

*Causes.*

SEROUS CYCLITIS.—This condition is hardly ever found without co-existing serous iritis. It is characterized by the effusion of serous fluid into the ciliary body, posterior and vitreous chambers. In some cases the tissue of the ciliary body becomes so distended by the serous effusion as to present the appearance of a trabecular network. Should the pupil be fixed to the lens, the serous fluid collects behind the iris and bulges it so far forwards as almost to touch the cornea. At the same time the epithelial cells of the posterior layers of the cornea become opaque in patches (keratitis punctata). The anterior part of the vitreous and posterior surfaces of the lens are not only impregnated with serous effusion from the ciliary body, but are also occupied by fibrine containing numerous round cells. This form of cyclitis may pass away without leaving any traces of its effects on the eye, the ciliary region however, is a dangerous locality to be attacked by disease of this kind.

Pathology of Serous Cyclitis.

*Symptoms.*—Serous cyclitis commences with impairment of sight, usually in one eye. The patient complains of a cloud or film over the visual field of the affected eye, which increases day

*Symptoms.*

by day. He has considerable pain in the eye, and tenderness on pressure over the ciliary region ; the amount of pain, however, varies much in different cases. On examining the eye we notice subconjunctival injection, often limited to isolated segments of the scleral zone. The aqueous humour is turbid, and in some instances flakes of opaque matter may be detected floating in it. The posterior layer of the cornea is hazy and dotted (keratitis punctata). As the disease advances the iris is discoloured, the pupil sluggish, and tied down by adhesions of greater or less extent to the capsule of the lens ; in some cases the pupil is entirely closed by neoplastic formations passing between it and the capsule. A few distended vessels may be seen coursing over the iris, and these are apt to give way and cause hæmorrhage into the aqueous chamber.

Changes in iris;

in dioptric media. Tension.

If the dioptric media of the eye are sufficiently transparent to allow of our examining its deeper structures, the vitreous will be found hazy, with flocculent bodies moving about in it. The tension of the eyeball is increased.

Advanced stages of disease ;

If the disease advances, the subconjunctival injection is augmented, and so also is the tension of the eyeball ; at the same time the patient's vision becomes more impaired. The synechiæ increase, and the fibrous structure of the iris is more and more disorganized, it becomes relaxed, and finally the "iris projects into the aqueous chamber irregularly, attaining a spongy appearance." This bulging forward of the iris is very marked, and is due to the collection of serous fluid behind it forcing forward those attenuated portions of the iris which are not tied down to the capsule of the lens. In the meantime the neoplastic growths about the pupil have been increasing, becoming organized and contracting, so that the pupil may be closed by a false membrane ; it assumes an irregular shape, appearing as an opaque patch or spot in the centre of the bulging iris. When the disease has advanced thus far the tension of the globe may become lessened. The iris undergoes degeneration, and the patient's sight is in fact almost lost, the globe rapidly undergoing atrophy. But in more favourable cases, after running a protracted course the eye gradually improves and the sight becomes fairly good.

iris bulges forward.

Pupil closed.

PURULENT CYCLITIS is most commonly observed after injuries to the ciliary region. It consists in suppuration of the ciliary body, and unless speedily relieved, ends in abscess of the globe of the eye. Purulent cyclitis may result from the degeneration of the cell formations produced in cases of plastic cyclitis. Under these circumstances, as I have before remarked, an hypopion forms in the anterior chamber. But from whatever cause the suppurative inflammation of the ciliary body starts, in consequence of its relation to the deeper tissues of the eye, the retina, lens, and vitreous seldom escape without irreparable mischief. Pathology of Purulent Cyclitis.

*Symptoms.*—The symptoms of purulent cyclitis are those of the plastic form of the disease intensified; the pain is often very great, the sclerotic zone of vessels and also those of the conjunctiva are much congested. The patient's sight is rapidly lost, the iris is cloudy, the lens and vitreous hazy. Pus is not unfrequently seen in the anterior chamber, the eyeball shrinks, and the patient's sight is totally destroyed. *Symptoms.*

*Prognosis.*—As in iritis, so in cyclitis, the prognosis will be more favourable in the serous than in the plastic form of disease. But whatever the form of the cyclitis, the first point we should consider in forming a prognosis is as to the state of the patient's vision. We should notice if he can see large objects—if he can count fingers held up before the diseased eye; if not, whether he can discern the flame of a candle in a dark room. Under the latter circumstances, we can give the patient but slight hope, for in all probability extensive lesions of the choroid and retina exist in addition to the cyclitis; but if he can count fingers or other large objects held before his eyes, and the disease is of the serous variety, we may reasonably hold out to our patient hopes of improvement, especially if the pupil dilates under the use of atropine. We shall also be guided in our prognosis by the tension of the globe; if the eyeball is soft we can hardly expect any amendment to occur, although if its tension is only slightly diminished it may possibly regain its normal condition. *Prognosis.* From the amount of sight

*Treatment.*—The treatment of cyclitis will evidently depend on its cause; if, as is not unfrequently the case, the disease depends upon sympathetic irritation propagated from the other eye, the *Treatment.*

sooner the latter is excised the better. And so with foreign bodies or injuries to the ciliary region—in each case the cyclitis is the result of causes which require special treatment. We may attempt to relieve the pain by leeches applied to the temples, belladonna fomentations, and so on. But plastic cyclitis, and still more the suppurative form of the disease, seldom yields to treatment of this kind, and if allowed to run its course is extremely apt to implicate the sound eye. So that an iridectomy failing to relieve the symptoms, we must insist on extirpation of the globe of the injured eye. We cannot hope to save the diseased eye, and its presence may very probably destroy the sound one.

Palliative.

Removal of globe of eye

When the cyclitis is referable to syphilis, we may in the early stages of the disease, by means of atropine, expect to keep the iris away from the lens, and so prevent the formation of synechiæ; at the same time iodide of mercury should be administered.

Specific treatment.

The serous form of cyclitis, like that of iritis, is most frequently met with in females suffering from vaginal or uterine troubles; and to effectually treat the cyclitis we must combat, if possible, the disorder which is the cause of general ill-health; local treatment, so far as the eye is concerned, will otherwise fail to cure a case of cyclitis depending on these causes.

Serous, attend to utero-vaginal troubles.

In both plastic and serous cyclitis I have spoken of the liability that exists for synechia to form, and to overcome this state of things we must resort to the operation of iridectomy. It is, in fact, frequently the only hope; and fortunately in some apparently most unfavourable instances of this dangerous form of disease iridectomy has a good effect.

Iridectomy.

It not unfrequently happens that, in attempting to perform an iridectomy in cases of cyclitis, we find that the iris is so firmly bound down to the capsule, that on withdrawing a fold of it for excision, it breaks away from its attachments to the capsule, leaving a narrow ridge of the iris in the former position of the pupil. An accident of this kind is of little consequence, but if inflammatory symptoms going on in the eye prior to the operation do not quickly subside, we may with advantage perform a second iridectomy from the other side of the eye, so that the

Directions for a second operation;

opposite halves of the iris are cut off from one another. It is advisable under these circumstances, if possible, to cut away a portion of the upper and lower sections of the iris, so that the opening through it may be partly covered by the upper eyelid. Nor does it always follow that the excision of a second portion of the iris is sufficient for our purpose. In bad cases of cyclitis we have Mr. Bowman's authority for excising a third section of the iris.* One reason for this is, that it is not improbable that the space from which we have excised a piece of the iris on the first and second occasions may have been, or may subsequently become, filled in by uveal growths, preventing light from reaching the retina ; nevertheless, these primary operations will have reduced the hyperaction going on in the part, so that subsequently to our third iridectomy the space occupied by the opening through the iris may remain clear; and thus the last operation is by far the most satisfactory, particularly in cases of serous cyclitis. In the plastic form of disease we cannot but fear, under any circumstances, that neoplasms will materially interfere with our best endeavours, and will occupy the space partially cleared by removal of a portion of the iris. In cases of this description we must not only remove a piece of the iris but in addition the neoplastic growth behind it. The straight iridectomy forceps are best adapted for removing such an iris; with this instrument portions of false membrane adhering to the posterior surface of the iris may be taken away, but their removal often endangers the lens; for this reason, and also because the lens pressing on the iris may add to the risk to which such an eye is exposed, Von Graefe advises the removal of the lens in addition to an iridectomy, by means of the following operation :—

and a third.

Management of neoplasms.

He makes the flap, if the condition of the cornea permits it, downwards, avoiding, if possible, wounding the iris ; but if the latter is greatly bulged forward, he passes the knife boldly through it, and in the latter case the capsule is already sufficiently divided to permit the ready egress of the lens. If this is

Graefe's operations

* *Ophthalmic Hospital Reports*, vol. iii. p. 230.

not the case, or the iris has remained untouched, he introduces a pair of straight forceps or a hook, and removes or tears as much of the iris and membrane as is necessary to permit the exit of the lens. After the operation a compress is to be applied, firm at first, and afterwards somewhat looser. There is generally only very slight reaction, so that it is only necessary for the patient to remain in bed for a day or two, and from five to seven days in a darkened room.

the removal of the lens.

In some of these cases the condition of the iris begins to improve after the lens has been removed. The anterior chamber becomes wider, and some patients have a little better perception of light. In many cases the ciliary neurosis is also much diminished. For bleeding into the anterior chamber a soft compress is best; sometimes the absorption of the blood may take as long as two to three weeks.

The iridectomy.

A month or six weeks after the extraction of the lens an iridectomy is to be performed. Von Graefe makes a large linear incision, and passes a sharply-pointed hook perpendicularly through the tract of the membranes. If on traction of the hook a clear black pupil of middling size becomes apparent, and the vitreous humour penetrates into the anterior chamber, he considers the dilaceration as sufficient. If this is not the case, a blunt hook or a straight pair of forceps should be introduced and the opening enlarged. The same will be necessary if a secondary cataract appears in the newly-made pupil. After this operation, according to the late Prof. Von Graefe, the cornea becomes plumper, and may re-acquire a good amount of curvature, but I cannot say my experience coincides with his in this respect.

## SYMPATHETIC CYCLITIS.

Sympathetic Cyclitis. Pathology.

Sympathetic Cyclitis, or Irido-choroiditis, is the result of morbid action excited by a wound or disease of one eye which is propagated to the sound eye, exciting in it a form of plastic cyclitis. The pathological changes met with in the early stages of sympathetic cyclitis are similar to those already described as characteristic of plastic cyclitis. But the more carefully I have studied these cases the more convinced I am that in

many instances, if the second eye is examined soon after it has become affected, evidence of optic neuritis will be found. I may here observe that the early stages of neuro-retinitis can only be recognized by means of the direct method of examination with the ophthalmoscope. Not a few cases of so-called sympathetic cyclitis, therefore, might more correctly be described as secondary neuro-retinitis; the optic nerve of the sound eye being implicated before there is evidence to show the ciliary body has been affected. Specimens exist demonstrating a condition of plastic neuritis in the optic nerve of a wounded eye, and also of the second eye; demonstrating the fact that the inflammatory action in the wounded eye had extended to its optic nerve, and in all probability by continuity of structure had implicated the optic nerve and papilla of the second eye. I shall return to this subject when speaking of papillitis. But admitting that neuro-retinitis may be excited in the second eye by continuity of structure, as described above, it remains equally true that, if the ciliary body has been wounded or otherwise irritated, that plastic cyclitis not unfrequently appears in the other eye without evidence of inflammation of the optic nerve in either eye. Moreover, in many cases of sympathetic cyclitis the evidence is in favour of the secondary cyclitis being the result of irritation of the ciliary nerves of the eye primarily damaged. This irritation may have been excited by a wound, operative or otherwise, involving the ciliary body. Perhaps the most destructive forms of injury that can occur are those in which the sclerotic is cut through, and the ciliary body becomes entangled in the cicatrix of the wound. In the same way, an anterior staphyloma may excite sympathetic irritation in the second eye. But it is well to bear in mind the fact that sympathetic disease may follow any form of spontaneous or acute inflammation, leading to the formation of neoplastic growth in the ciliary body; these, as they contract, exercise traction on the ciliary nerves, and so are very apt to excite sympathetic disease in the other eye.

Neuritis

*Symptoms.*—In the early stages of sympathetic cyclitis it frequently happens that the patient simply complains of dimness of vision as the first symptom of the disease in the otherwise

*Symptoms.*

unaffected eye; objects appear as if seen through a cloud, especially in a dull light; so marked a feature is this of the complaint that it is sometimes mistaken for night blindness. As the disease advances the patient complains of opaque bodies floating about before his eyes. These symptoms depend on haziness and subsequent fluidity of the vitreous humour. There may be little or no pain in the eye, and the sclerotic zone of congested vessels may be wanting. The pupil responds but slowly, if at all, to the stimulus of light, and frequently takes a considerable time to act, on the instillation of strong mydriatics.

Symptoms, when progress slow.

In other cases the primarily diseased eye is perhaps tender on pressure, and neuralgia of the brow and temple is now and then experienced. Under these circumstances, it may be without the patient suffering any pain in it, we notice a slight amount of subconjunctival injection in the hitherto sound eye, and on close examination we find the iris is discoloured, and its fibrous structure indistinct; it does not respond sharply to the stimulus of light, and the anterior chamber is perhaps diminished in depth. Evidence of neuro-retinitis may often be detected by the direct method of ophthalmoscopic examination. Besides these symptoms, the patient begins to complain of pain in the eye, especially if pressure is made over the ciliary region, photophobia, lachrymation, and supra-orbital neuralgia. After a short time the pupil ceases to respond to light; and on atropine being dropped into the eye, we find posterior synechia has already formed, and this, rapidly increasing, glues the iris down to the capsule of the lens, the pupil being frequently closed by neoplastic growths, which may assume a yellowish colour. Corresponding changes occur in the stroma of the iris and choroid; their fibrous structure becomes atrophied and destroyed. The lens and vitreous participate in these degenerative changes, and the eye in too many cases is destroyed.

Symptoms often slight at first.

Signs of iritis,

of neuritis.

Synechia.

Atrophy.

There is another class of cases, which may be distinguished from sympathetic inflammation, and are in truth instances of sympathetic irritation; they are of a less severe nature than either of those described. In these cases, from injury or disease, a patient loses one eye totally or in part. It may be that he suffers no pain or irritation in the damaged eye; but from time

"Sympathetic irritation."

to time, from overwork, or overfeeding, very probably the two combined, with excessive smoking, the sound eye becomes irritable and congested, the subconjunctival zone of vessels is injected, there is intolerance of light, and an aching pain over the brow, these symptoms being augmented by using the eye. The tension of the eyeball is normal, and the pupil responds to the stimulus of light. After a few days' rest, and perhaps a little judicious starving, the eye resumes its normal appearance and functions, and the patient continues his work as usual. These symptoms may continue for years without inducing any further ill consequences; but if we find in addition to these troubles that the patient has tenderness over the ciliary region of the second eye, the tension of the globe being increased, and that his vision is becoming impaired—it may be only slightly hazy—and the accommodation less sharp than heretofore, perhaps the pupil also acting sluggishly, then we have probably no longer to deal with sympathetic irritation, but with sympathetic cyclitis in its early stages, and our prognosis even then will be a grave one in proportion to the advance made in these symptoms before the patient comes under our observation. There can be little doubt that instances of this form of disease are not unfrequently due to neuro-retinitis. And under these circumstances we can understand that the removal of the primarily diseased globe will not stop the neuritis already established in the second eye.

*Symptoms.*

Less dangerous.

*The Prognosis* of sympathetic cyclitis is always unfavourable, although in its early stages the removal of the diseased eye may possibly save the sound one; but when once structural changes have occurred in one eye consequent on irritation going on in the other one, we can have but little reasonable hope of saving the second eye. As a general rule, sympathetic disease spreads from an injured or diseased eye to the other one within a period of a few weeks or months, but it may happen that years pass over before this dangerous affection is called into activity in the second eye, or that it becomes so far advanced as to attract attention, and it is then very probably too late to remove the diseased eye. The operation of excision may be followed by temporary relief under these circumstances, but cannot be

*Prognosis.* Mostly unfavourable.

depended upon for the arrest of the abnormal action in the second eye.

*Treatment.* *Treatment.*—I have in the above remarks so repeatedly observed that the disease we are now considering has its point of departure in a diseased or injured eye, that we can readily understand the necessity of removing a diseased globe under these circumstances. As a rule, therefore, the sight of one eye having been destroyed by a wound or disease involving the ciliary region, it is a fatal mistake to wait until symptoms of hyperaction occur in the other eye; we should at once recommend the excision of the diseased globe. If symptoms of sympathetic cyclitis or neuritis have been established in the second eye, we cannot assure the patient that the disease will not progress, even if the primarily diseased globe is excised. It is the proper treatment to adopt, but by no means a specific against further mischief, and almost useless if structural changes and tenderness over the ciliary region or optic nerve of the sound eye have commenced.

Early excision of diseased eye.

The treatment of the eye in which disease has been established by sympathetic irritation is most unsatisfactory. We should endeavour to keep the pupil fully dilated with atropine, and the eye should be maintained in a state of perfect rest, the patient remaining in a dark room, and partaking only sparingly of food. By a soothing plan of treatment we may hope to quiet down the inflammatory attack from which the patient may be suffering, at any rate for the time being; but recur it is almost certain to do, and each attack adds to the damage already inflicted on the eye. Nor can we with any confidence fall back upon an iridectomy in instances of sympathetic cyclitis; in the early stages of the disease it may perhaps be attempted, but I fear with but little hope of relief; in the latter stages the iris becomes so rotten, and firmly glued down to the capsule of the lens, that it breaks away when seized by the iridectomy forceps, and it is useless therefore attempting the operation.

Atropine and rest.

Iridectomy seldom avails.

## CHAPTER X.

## DISEASES OF THE CHOROID.

*Changes in the Hexagonal Cells and Lamina Vitrea—Choroiditis Disseminata—Acute Serous Choroiditis (Glaucoma Fulminans)—Suppurative Choroiditis—Extravasation of Blood into the Choroid—Tumours—Tubercle and Wounds of Choroid—Posterior Staphyloma (Sclero-Choroiditis Posterior).*

Disease of Lamina Vitrea.

THE hexagonal cells interposed between the lamina vitrea and retina (Fig. 7, p. 18) like many of the cells of the choroid, contain pigment. Under certain conditions some of these cells appear to part with, and neighbouring cells to appropriate, this colouring matter. We frequently meet with examples of this kind in instances of choroiditis. In the majority of cases of inflammation of the choroid the hexagonal cells of the lamina vitrea multiply, to a greater or less extent, the cells forming processes or cylinders which pass into the retina. In the disease known as "retinitis pigmentosa" the growth of the hexagonal cells into the retina is very remarkable, and forms the characteristic feature of this affection.

Among dark-skinned races, such as the natives of India, the hexagonal cells are so full of black pigment that, when the eye is examined with the ophthalmoscope, the fundus appears of a slate colour, the rays of light being unable to reach the choroid. I have frequently, however, seen cases in which the whole of the pigment in the hexagonal cells appears to have been removed in the course of a short time. The fundus of an eye which has been of a uniform slate colour, speedily assumes quite a diffe-

rent aspect, being covered by an intricate network of choroidal vessels. But I have never been able to satisfy myself that hexagonal cells which have parted with their pigment ever regain it.

Colloid diseases.

*Colloid Diseases of the Lamina Vitrea.*—It not unfrequently happens that, on examining eyes which have been subject to frequent attacks of inflammation, small yellowish prominences are noticed on the inner surface of the lamina vitrea. These minute excrescences resemble those seen in the membranes of the brain, and, like them, they frequently undergo calcification, so that they effervesce on the application of a strong acid, and when cut, the edge of the knife grates against them. These colloid bodies are most abundant near the equatorial region of the eye, but always at some distance from the papilla; they are at times detached from the lamina vitrea, and become imbedded in the retina. In cases of colloid degeneration of the lamina vitrea the fundus of the eye appears to be sprinkled over with minute dots, either with, or independently of evidence of choroiditis.

## CHOROIDITIS.

Choroiditis. Pathology.

In cases of choroiditis the abnormal action, which is frequently of a sub-acute nature, commences with hyperæmia of the vessels and exudation into the choroid. The diseased action is generally confined to a limited area, and the exudation in the first instance closely resembles that seen in cases of iritis. Greyish-yellow nodules of exudation appear in the choroid; these extend and becoming organized, are converted into white patches of neoplastic tissue, surrounded by a border of black pigment. As the abnormal action extends, it generally involves the lamina vitrea, which may be perforated, and the surrounding portion of the retina becomes infiltrated with exudation from the choroid. In this way a choroido-retinitis is established, and in the course of time white patches, surrounded to a greater or less extent by black pigment, appear in the retina.

In other cases the exudation is confined between the layers of the choroid (p. 18), and the lamina vitrea becomes glued down to the sclerotic, the intervening choroid is entirely destroyed,

and white patches remain to indicate the site of the previous exudations. These are patches of choroidal atrophy. Pathology.

The choroid is frequently found to be occupied by extensive patches of neoplastic growth, and yet the vitreous and lens continues transparent, unless in syphilitic choroiditis. But even in non-specific cases of choroiditis, after a certain time the vitreous is apt to undergo liquefaction, and under these circumstances detachment of the retina is common.

Cases of choroiditis have been classified under several heads, but for all practical purposes they may be divided into non-specific and specific choroiditis disseminata, acute serous, and lastly, suppurative choroiditis.

CHOROIDITIS DISSEMINATA (NON-SPECIFIC).—When we describe a choroiditis as non-specific we simply mean that it is impossible to discover any traces of either acquired or inherited syphilis in connection with the case. A patient suffering from this form of disease applies to us on account of gradually increasing dimness of vision. The conjunctiva and other external structures may appear to be healthy, and the patient has probably suffered from little or no pain in the eyes. On examining the eye with the ophthalmoscope in the early stages of the disease we frequently notice a number of small yellowish-white spots in the choroid, near the macula lutea. Not unfrequently the space bordering some of the choroidal vessels will be marked by a fine grey line. As the disease advances, white patches of variable size and form, surrounded by a border of black pigment, are seen scattered throughout the choroid (Plate III., Fig. 3). That these patches are situated in the choroid is evident from the fact that the retinal vessels pass over them. In other cases, if the diseased action has involved the retina the vessels extend up to the margin of the patch, but not into or over it. In the majority of these cases the optic disc is of a decided red colour, but the vitreous and lens usually remain transparent until an advanced stage of the disease, when black flakes, forming floating bodies, may be seen in the vitreous. These flakes are best detected by the direct method of examination, whenever the patient moves his eye. In not a few cases detachment of the retina ultimately occurs, and the lens becomes opaque.

CHOROIDITIS DISSEMINATA.

*Symptoms.*

Ophthalmoscopic appearances.

*Treatment.* The greater number of cases of non-specific choroiditis depend upon changes commencing in the choroid, the result of an advancing posterior staphyloma. The increasing myopia from which such patients suffer obliges them to exercise an inordinate amount of accommodation and convergence, and so changes in the nutrition of the contents of the eyeball are established. This condition can only be remedied by ordering proper concave glasses to neutralize the myopia. In other cases of non-specific choroiditis we are often entirely ignorant of the causes which give rise to the changes in the choroid; gout or rheumatism are doubtless accountable for some cases. The progress of the disease is frequently extremely slow; we may observe patients year by year without noticing much alteration in their acuteness of vision, the lens and vitreous remaining transparent. A change for the worse may at any time, however, occur in the shape of detachment of the retina or hæmorrhage into the retina and vitreous. There is little to be done in the way of local treatment in cases of this description. The patient's general health must be attended to, and the eyes guarded from over work, any special symptoms being dealt with as they arise.

Syphilitic Choroiditis.

SPECIFIC CHOROIDITIS DISSEMINATA.—Most of the cases of choroiditis we meet with in practice are instances of this kind. The disease, in the greater number of cases, is complicated by changes in the optic disc and retina, so that the condition is one of choroido-retinitis; not only is the retina involved but the vitreous is frequently, from an early stage, implicated.

*Symptoms.*

Vitreous affected.

A patient suffering from syphilitic choroido-retinitis applies to us most frequently for pronounced defects in the sight of one eye, the other eye commonly, in the course of a short time, being affected in the same way. He not only complains of great imperfection of sight, but also of spots or flakes floating across the field of vision. In many cases the patient sees a clearly defined reddish-yellow spot moving tremulously before the affected eye; this spot is very distinct when he passes from a dim into a bright light. There is seldom much, if any, pain in the eye, and the conjunctiva and iris may appear healthy.

Ophthalmoscopic appearances.

On examining the eye with the ophthalmoscope in a case of

syphilitic choroido-retinitis we perceive floating bodies in the vitreous. In the early stages of the disease the vitreous seems to be full of dust ; these particles coalesce and form flakes, which float about in all directions every time the patient moves his eye. These floating bodies are apt to render the details of the fundus of the eye somewhat obscure, but the optic papilla is of a deep red colour, and its outline is indistinct from plastic exudation, which extends to a greater or less extent over the retina. In addition to these changes in the vitreous and retina, white patches surrounded with black pigment may be seen in the choroid.

*Prognosis.*

Cases of syphilitic choroido-retinitis may, if brought under treatment in an early stage of the disease, entirely disappear, the vitreous and retina gradually clear, and the fundus of the eye assumes its normal appearance. But the disease is subject to constant relapses, and the fibro-cellular elements which have formed in the retina, and especially along the peri-vascular sheath of its vessels, become organized, and in contracting lead to atrophy of these structures. White patches surrounded with black pigment form along the course of the retinal and choroidal vessels. In some cases the black patches in the retina assume an appearance very like those seen in retinitis pigmentosa. In other cases the vitreous becomes extremely hazy, choroidal exudations occur round the papilla and spread into the vitreous. If the vitreous again clears large bluish-green streaks mingled with masses of black pigment are seen bordering the vessels. Changes of this nature, if they occur in or near the macula lutea, cause a far greater permanent or temporary loss of sight than if they form towards the periphery of the retina.

*Treatment.*

In the treatment of specific choroido-retinitis, whether the result of acquired or hereditary syphilis, we must rely upon mercury. Perhaps the iodide of mercury is the drug we may with the greatest advantage prescribe in these cases, and its use must be continued for several months. It is surprising how soon the hazy vitreous clears under treatment of this kind. In fact, it is unwise to venture on a prognosis in these cases until the patient has for some time been under the influence of iodide of mercury, for it is impossible to predict how far he may recover his sight.

Considering the intimate relations that exist between the choroid and the iris, it is advisable in most cases of choroido-retinitis to keep the pupil fully dilated. The exception to this rule is when there is any increased tension of the eyeball, under which circumstances, in place of atropine, a solution of sulphate of eserine should be applied to the conjunctiva twice a day.

Acute Serous Choroiditis

ACUTE SEROUS CHOROIDITIS (GLAUCOMA FULMINANS) SEROUS CHOROIDITIS.—In the first edition of this work I gave the following description of acute serous choroiditis, and up to the present time my ideas on the subject have undergone no material change. The following cases, published in 1868, illustrate the nature of the disease :—

Case I.

CASE I.—K, aged thirty-five, came under my care on the 22nd of January. Until within the last five years his eyesight had been perfect ; he was then at Lahore, and was suddenly seized with violent pain in the left eye, which became red and inflamed ; he speedily lost the sight in it. The pain in the eyeball continued for some two or three months, and then gradually passed away. He came to consult me about the right eye, which had been healthy, and the sight perfectly good, until within the last three days, when he was attacked with violent pain in it, extending over the side of the head. The patient was led into the hospital ; indeed, he could only just distinguish light from darkness ; the tension of the globe of the right eye was T + 2, the pupil was dilated, and the lens and vitreous were hazy, the former being pushed forward so as almost to touch the cornea, which was dull and insensible; there was considerable congestion of the vessels of the sclerotic and conjunctiva.

Previous loss of one eye.

Pain, tension, loss of sight in other.

Dilated pupil, hazy humours.

Venous congestion of retina.

Cupped disc.

Hyperæmia of choroid.

The veins of the retina were congested, the retina itself was œdematous, and the optic disc cupped. The retinal vessels, after passing over its edge, were evidently on a plane anterior to the one they had occupied when crossing the optic disc. The pulsation of the arteries was well marked. The hexagonal cells of the lamina vitrea were destroyed,and the vessels of the choroid could be plainly seen through the retina ; and as the appearance of the pigment-cells of the stroma was almost entirely lost, I concluded that the capillaries, as well as the larger vessels, were deeply congested. Towards the ora serrata, there were numerous small

patches of extravasated blood in the choroid; they did not, however, extend inwards towards the axis of vision.

Iridectomy was performed on the 22nd of January, at 9 A.M.; the patient was then almost blind, and in the most intense agony. At 2 P.M. I saw him, and he was comparatively free from pain. On the following morning I found he had slept well during the night; he was free from pain, and on opening the eye he could distinguish the features of my face. His vision continued to improve till he left the hospital, when the sight in the right eye had become as good as it had ever been; the tension of the globe was normal, and the conjunctival and sclerotic congestion had entirely disappeared; the optic disc and retina were healthy. Iridectomy. Instant relief. Favourable results.

Before proceeding to make any remarks on this case, it may be well to cite another of a similar nature, but unfavourable termination; and though the result does not redound much to my own skill, still it conveys a most important lesson when contrasted with the instance above detailed.

CASE II.—I., aged forty, was admitted into the Ophthalmic Hospital on the 5th of November. He had good sight up to within four days of his admission, when he was seized with a violent pain in the right eye, and in a few hours the sight became so dim that he could only see a short distance in front of him. He came to the hospital, as I said, four days after the commencement of the attack. I then found the conjunctiva and the sclerotic much congested; the tension of the eyeball was T + 3; the pupil was dilated, and did not respond to the stimulus of light; the lens and vitreous were too opaque to allow of my seeing the retina or optic disc distinctly, but there was evident congestion of the vessels of the choroid; the lens was thrust forward, and it required care to avoid wounding it in making the necessary incision for iridectomy. Case II. Symptoms as in the former.

There could be no doubt that the proper plan of treatment consisted in the performance of this operation, and the patient was therefore placed under the influence of chloroform; but before I had completed the requisite opening in the anterior chamber he commenced vomiting, and the operation was thus delayed. As the man was constantly belching and retching I Iridectomy. Operation incomplete.

was anxious to discontinue the administration of the chloroform as quickly as possible, lest by these straining efforts, the congested vessels should be ruptured, and destructive hæmorrhage take place into the choroid; and consequently I only managed to excise a small portion of the iris, without taking sufficient care to pull it away from its attachments.

In the evening the pain in the eye had not diminished, and the eyeball still felt somewhat full, though not nearly so tense as in the morning. The patient, however, suffered from excruciating pain during the following three days; and as the tension of the eyeball was then very great I determined to operate again, and to excise a larger portion of the iris. This was effectually done, and care was taken, this time, to pull it away from its attachment; in fact, the operation of iridectomy was now performed, and not the mere removal of a portion of the iris, as on the previous occasion. From this time the pain and tension of the eyeball gradually subsided; but, unfortunately, the three days' delay between the first and second operations had been fatal to the patient's vision, extensive detachment of the retina having occurred.

Repetition.

Unfavourable result.

My object in dwelling on this unfortunate case has been to press this important point in connection with the operation of iridectomy: That it is not sufficient simply to excise a portion of the iris, but the part must be removed from its attachment, in order to ensure the benefits which the operation is capable of affording. Unless this point be attended to we might just as well leave the iris alone, and simply puncture the sclerotic. It is a mistake to put off the operation an hour longer than is necessary, but during this time apply eserine to the eye frequently.

Iridectomy, its importance.

The question naturally arises, How can iridectomy effect such marked benefits as we see following its employment in cases of this kind?

Nature of its operation.

Dr. Johnson has described the space included between the sclerotic and lamina vitrea (p. 18), as being occupied by the structures of the choroid and ciliary body. If the nozzle of a fine syringe be inserted beneath the sclerotic, this sac can readily be injected to such an extent as to make the globe of the eye very

Experimental illustration.

tense. In practice, we find that this may be done, and yet not a particle of the injected fluid will escape through the elastic lamina.

Suppose, for instance, we inject some of Beale's blue fluid into the choroid of a Bengalee's eye, which has been recently removed, and then slice off the cornea, not a vestige of the fluid will be seen till the black hexagonal cells have been removed, when the blue fluid will be noticed behind the lamina vitrea, extending from the ciliary body to the optic disc. If this space has been carefully and fully injected, so as to make the eyeball of stony hardness, and if a needle be then passed into the anterior chamber, in front of the iris, and its point be made to press back the pillars of the iris, thus puncturing the ciliary body; the coloured fluid will immediately pass out into the anterior chamber; and as the needle is withdrawn from the eye, and the aqueous humour escapes, its place will be occupied by the injected fluid from the choroid, and as this occurs the previously tense globe will become soft. I cannot help thinking, therefore, that the success of the operation of iridectomy in acute choroiditis depends upon the fact of the ciliary processes being opened, and the effusion behind it escaping into the anterior chamber; and hence the benefit of the proceeding in the case of K., and its failure in that of I.

Connects choroidal sac and ant. chamber, by rupturing elastic lamina.

It seems to me that, although cases of acute serous choroiditis are characterized by increased tension of the eyeball and cupping of the optic disc, nevertheless they should not be classified under the head of glaucoma. Dr. Alt remarks of cases of acute serous choroiditis, that the "accumulation of serous fluid within the eyeball, especially when its means of exit are pathologically altered, may so increase the intra-ocular pressure, that we find, later on, the symptoms of glaucoma, including cupping of the papilla." On referring to the able description given by Dr. Johnson of the anatomy of the lymphatic system of the eye, we can, as I have before remarked, explain the circumstances of acute serous choroiditis (p. 9). For if sudden effusion of serous fluid takes place between the lamina vitrea and the sclerotic, the escape of venous blood and lymph from the eye must be greatly impeded (Fig. 5, p. 12). At the same time, if under these circumstances a free opening is established (by means of an iridec-

Explanation of symptoms of serous choroiditis.

tomy) from the ciliary body into the anterior chamber, the excess of serous fluid can then drain away through Fontana's spaces and the anterior lymphatic channel.

SUPPURATIVE CHOROIDITIS. Pathology.

SUPPURATIVE CHOROIDITIS is most frequently the result of a wound or a foreign body lodged within the eyeball. For instance, in India, where the operation of reclination for the relief of cataract is commonly practised by the natives, we frequently meet with instances of suppurative choroiditis. Intense inflammation, commencing in the choroid, speedily extends to the contents of the sclerotic, and suppuration of the globe occurs. I have seen this condition on several occasions in patients suffering from pyæmia, indicating an analogy between certain elements of the choroid and the synovial cavities. This analogy is strengthened by the circumstance that in atrophied eyeballs we often find a plate of bone between the choroid and retina. This new bone is formed from the lamina vitrea, a structure which must consequently have been derived from the same embryonic element as temporary cartilage.

*Symptoms.*

*Symptoms.*—In cases of suppurative choroiditis the conjunctiva is red and œdematous, the eyelids of brawny hardness and swollen. The aqueous chamber soon becomes filled with turbid fluid mixed with pus. The cornea and lens become dull, and the former infiltrated with matter; an irregular sloughing ulcer forms in it, through which the contents of the globe escape.

The patient during the suppurative stage of the disease suffers from acute pain, generally of a throbbing character, in the eye extending to the head and side of the face. There is often considerable constitutional disturbance, and utter inability to obtain rest, in consequence of the severity of the pain.

In by far the majority of instances of abscess of the eyeball the cornea suppurates and the contents of the globe escape relieving the tension, and the patient's sufferings.

*Treatment.*

*Treatment.*—The treatment of suppurative choroiditis is most unsatisfactory. The eyelids should be painted over with a strong solution of nitrate of silver. It is sometimes possible to raise the upper lid slightly, and keep it in this position by means of strips of adhesive plaster, so as to prevent the pressure which it otherwise exercises upon the inflamed globe.

The extract of belladonna must be frequently smeared over the forehead and beneath the affected eye. The pain is sometimes relieved by hot belladonna fermentations, but, as a rule, subcutaneous injections of morphia once or twice a day are necessary. By puncturing the cornea with a broad needle, so as to allow the aqueous to escape, we may relieve the tension of the globe, and often afford the patient very considerable relief. If this operation gives the patient ease, it may with safety be repeated in the course of thirty-six hours; but if, after once tapping the anterior chamber, the pain in the eye is increased, it should not be again attempted.

Should the disease continue to progress, and suppuration of the globe follow, the eyeball should as soon as possible be excised.

Tubercle in the Choroid.

TUBERCULOSIS OF THE CHOROID.—The growth of tubercles in the choroid has been noticed among persons suffering from tuberculosis of the meninges of the brain. If in a case of this description the patient's eyes are examined with the ophthalmoscope, pale yellow or rose-coloured patches, with ill-defined margins, may be seen, usually situated near the optic disc; their raised and uneven surface can hardly be mistaken for any other condition of the parts. As the disease advances, the functions of the choroid become impaired, and the vitreous passes into an opaque condition, rendering further changes in the structures posterior to it very indistinct.

Raised patches.

Sarcoma its characteristics.

SARCOMA OF THE CHOROID, like similar abnormal growths in other parts of the body, is characterized by a preponderance of cellular elements, of a stellate, spindle-shaped, or round form, resembling those of certain embryonic tissues. These cells differ materially from those of connective tissue, in that they are incapable of passing into the stage of perfect development. They are, however, in combination with leucocytes, prone to form a relatively firm, vascular, and coherent structure. In sarcoma we often find the cellular elements not only preponderating, but containing a quantity of dark pigment, assuming the melanotic form. This is especially the case when the disease springs from

Cells often contain pigment.

a structure already containing much pigment, as is the case with the choroid.

*Symptoms.* *Symptoms.*—Sarcoma of the choroid commences as a slight elevation or patch in the choroid; the iris is soon seen to bulge forwards towards the cornea, the pupil is dilated, and a greyish projection may be observed through it, growing from the fundus of the eye. As the tumour advances forwards a collection of fluid takes place between it and the opaque retina; the latter forms an undulating projection, vibrating with every movement of the eye, and clearly recognizable in the vitreous chamber by aid of the opthalmoscope. The intra-ocular tension is increased, and the patient usually suffers intensely from pain in the eye and over the corresponding side of the head. A sarcoma in this situation increases rapidly, but may be interrupted by periods of inactivity. As the sarcoma grows, involving more of the choroid, the lens and vitreous become opaque, and at a later period the cornea gets opaque.

Advanced stage of disease. As the disease advances, a staphylomatous protrusion may appear in the ciliary region, from degeneration of the sclerotic. The cornea or sclerotic is perforated, and the tumour passes through the opening, presenting as a dark, soft, fungating mass. In many instances sarcoma of the choroid has been known to grow along the course of the bloodvessels backwards into the orbit, so as to thrust the eye outwards, protruding it from between the eyelids, before the nature of the tumour behind could be exactly ascertained.

*Treatment.* In first stage remove the eyeball. *Treatment.*—In the early stages of both sarcomatous and carcinomatous affections of the choroid, and as long as the growth is confined within the globe, we should certainly attempt to remove the disease by excising the eye. Subsequently, when the tumour has burst through the sclerotic and involved the parts around, in my opinion we are not justified in attempting to remove it with the knife.* We may diminish

* "A Practical Work on the Diseases of the Eye," by F. Tyrrell, vol. ii. pp. 165–187; Dalrymple, "Pathology of the Eye," Pl. XXXIII. (letterpress.)

the patient's sufferings by means of anodynes, and the vapour of chloroform applied to the surface of the growth: but beyond attempting to relieve pain little can be done. Later, relieve pain.

WOUNDS AND INJURIES OF THE CHOROID.—It is evident from the protection the choroid receives from the parts around it, that it cannot be wounded unless the sclerotic or other external structures of the eye are injured. In incised wounds through the sclerotic, hernia of the choroid seldom occurs, in consequence of the intimate connection which exists between these structures. WOUNDS OF CHOROID. Hernia seldom occurs.

Blows inflicted on various parts of the eye are by no means unfrequently followed by a rupture of some of the bloodvessels of the choroid. If the effusion of blood is considerable, it bursts through the retina, and infiltrates the vitreous body, probably finding its way into the anterior chamber. Cicatrices of wounds in the choroid, following contusion of the eyeball, have been noticed during life by means of the ophthalmoscope.* In other cases a clot of blood may form in the choroid, and may be seen with the ophthalmoscope, the retinal vessels crossing over it.

In more severe cases, the patient may completely lose the sight of the injured eye from the instant the accident has occurred, though he may suffer from little or no pain in it. On examining the eye we shall find, very probably, that the anterior chamber is full of blood; or it may happen that the hæmorrhage has not reached so far forwards, but that on dilating the pupil and examining the eye with the ophthalmoscope, we find the vitreous opaque, and infiltrated with blood. In some instances of injuries to the eye the hæmorrhage is limited, and the patient only complains of haziness of vision, depending upon a displacement of the retina forwards by a clot of blood in the choroid. Sight lost for the time. Blood in the anterior chamber or vitreous.

*Prognosis.*—This will vary according to the apparent nature *Prognosis*; must be guarded.

* See cases reported by Dr. P. Frank, *Ophthalmic Hospital Reports*, vol. iii. p. 84.

of the lesion. I say apparent, because if the hæmorrhage has been considerable, it is impossible to ascertain the extent of the damage done to the eye until the blood has become absorbed; but it rarely happens that hæmorrhage of this kind takes place within the eye without breaking down the attachments of the retina, or otherwise damaging the eye as an organ of vision.

Retina often detached.

In the less severe cases, the clot of blood may be absorbed in the course of a few days, and the functions of the eye will be perfectly restored.

Liability of myopics.

Hæmorrhage from the choroidal vessels is evidently far more apt to follow an injury to the eye if the choroid is diseased. We meet with instances of the kind among persons suffering from myopia consequent on extensive posterior staphyloma. The imperfection of vision from which such patients suffer renders them less able to guard themselves from injuries to the eye than other persons; and, at the same time, their eyeballs are often prominent. Moreover, the diseased state of the choroid renders its vessels more liable to be ruptured by a blow on the eye. I have met with several instances of this kind, where the accident has been followed by hæmorrhage into the vitreous; and it has been subsequently discovered that extensive detachment of the retina had occurred. Even where the retina escapes, the blood in these cases, oozing into the choroid, may damage its structure, and it subsequently becomes extensively atrophied; this state of things is often followed by opacity of the lens and vitreous.

Unfavourable termination.

*Treatment.*

Cold to eye.

*Treatment.*—If the accident has only recently occurred, it is advisable to apply ice to the eye, and keep the organ at rest, so as, if possible, to stop any further hæmorrhage. But if the accident has taken place some time before we see the patient, we should keep the eye at rest with a pad and bandage until the effused blood has become absorbed. In cases of extensive hæmorrhage from the choroid the result of gun-shot, or an incised wound of the sclerotic, supposing the patient's sight is absolutely destroyed, it is advisable to remove the eyeball as soon as possible, in order to save the sound eye from an attack of sympathetic cyclitis.

Rest.

We occasionally meet with cases of hæmorrhage into the choroid resulting from an engorged state of its vessels, as in glaucoma, or after over-exertion of the eye. The effused blood presents a uniform dark crimson appearance, varying in shape and size, the hæmorrhage being on a plane posterior to the retina. The retinal vessels passing over the clot can be clearly recognized with the ophthalmoscope. The extent and situation of a clot of blood will, under these circumstances, lead us to a prognosis ; small spots of hæmorrhage, if near the ora serrata, may become absorbed and leave the eye, as regards vision, comparatively uninjured, and this may be the case even with large effusions in the axis of vision, but scotomata more commonly result; and the hæmorrhage depending on some local disease is apt to return.

Hæmorrhage into choroid may result from disease.

DETACHMENT OF THE CHOROID from the sclerotic may occur as the result of an injury or from disease, as, for instance, the growth of a tumour in the choroid.* With the ophthalmoscope we may observe the rent made in the choroid, and through it the white and glistening sclerotic can be seen. In these cases the retina is of course detached with the choroid, and the sight of the eye is therefore irrevocably lost at the seat of injury.

DETACHMENT OF CHOROID.

Loss of sight.

In some rare cases the choroid is only partially detached from the sclerotic, by a collection of blood or serous effusion forcing its way immediately within the sclerotic, and tearing the choroid from its attachments, bulges it forward, together with the retina, into the vitreous chamber: the most characteristic symptom is the appearance of the choroidal vessels and intra-vascular spaces lying close beneath the retina.† The protuberance thus formed may be seen by transmitted light, and might be mistaken for a malignant tumour springing from the choroid ; but in

Partial detachment.

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* *Ophthalmic Review*, vol. i. p. 79.

† "A Treatise on the Diseases of the Eye," by Soelberg Wells, 3rd edit., p. 511.

instances such as I am referring to, the history of the case and the absence of other symptoms indicative of malignant disease, will lead us to a correct diagnosis.

Sympathetic Choroiditis.

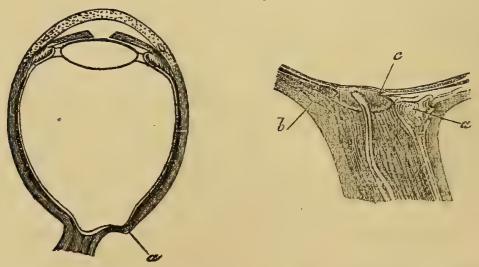
SYMPATHETIC IRRITATION OF THE CHOROID (*see* Cyclitis).—I have already described (p. 290) the symptoms of cyclitis, or irido-choroiditis, which, as I then remarked, is by no means uncommonly induced by wounds or injuries involving the ciliary body or the choroid.

## POSTERIOR STAPHYLOMA, SCLERO-CHOROIDITIS POSTERIOR.

Pathology.

The sheath of the optic nerve is divided into two parts (Figs. 46); the outer (*b*) runs into the sclerotic, and the inner (*c*)

FIG. 46.




envelopes the trunk of the nerve as far as the choroid; the two are separated by loose connective tissue (*a*) (*see also* p. 14). In cases of posterior staphyloma the choroid becomes atrophied to a certain extent round the optic disc, and the sclerotic bulges backwards at this point.*

Eyeball elongated backwards.

This fact is confirmed by the condition of eyeballs affected with posterior staphyloma; after removal, such eyes are found to project backwards (Fig. 46, *a*), to a greater or lesser extent, round the margin of the optic papilla, and the choroid lining this

* *Archiv für Ophthal.*, Band. i. Abth. ii. p. 82, 1855.

projection or staphyloma is found to be atrophied, the sclerotic itself being attenuated at this spot.

Among myopics, accommodation and convergence of the optic axes are called into play to a greater extent than in emmetropics; the latter action is especially augmented. In its normal condition the globe of the eye is kept in a state of equilibrium, and its spherical form is conserved by the recti and obliqui muscles (p. 2). When the eye is turned in any direction the opposing muscle relaxes in exactly the same proportion as the other set of muscles contracts, and in this way injurious pressure on the globe is prevented. Myopics are subject, therefore, to increased intra-ocular pressure, because of the excessive convergence of their eyes on near objects in order that they may see clearly; and in this way increased tension of the eyeball and venous congestion of the choroid is established, and so softening and extension of the tunics of the eyeball occurs at the optic papilla, the point of least resistance. The choroid being stretched at this point undergoes consecutive atrophy, and in many instances inflammatory action is set up, producing choroido-retinitis, and complications involving the vitreous.

Causes of the elongation.

Aggravated in myopics by habitual near sight.

Cases of posterior staphyloma may be divided into two classes: the first, in which the disease is stationary, and the second, in which it is advancing.

Two classes of cases.

1. *Stationary Form.*—In this form the patient suffers from myopia, which may not have been noticed until he has reached the age of twelve or fifteen years. I have seen several cases in which the defective vision was first discovered upon a boy's attempting to decipher words or figures on a blackboard at a distance of thirty or forty feet; his fellow-students could probably readily make these words out, but they appeared hazy and ill-defined to the short-sighted lad, unless he went up to within a few yards of the board. Under these circumstances, on examining the eye, we not unfrequently find that it appears to be more prominent than natural, it consequence of its being elongated from before backwards. The posterior segment of the eye, when inverted, is perhaps of a slightly bluish colour: and the patient com-

1. Stationary. Myopia; overlooked in children.

plains of a feeling of fulness and pain in the eye after long-continued work.

With the ophthalmoscope, in a well-marked instance of this kind, the appearance of the optic disc is characteristic ; it seems to be distorted in shape and altered in size, in consequence of the formation of a crescent of a brilliant white colour, which has formed usually on the outer side of the disc. The crescent may vary much in size, from a small white arc to a large zone, and extends perhaps all round the disc, embracing even the region of the yellow spot, its greatest extent usually being in the latter direction (Plate III., Fig. 2). This crescent is due to thinning and atrophy of the choroid over the part affected, so that the glistening sclerotic shines through it, producing the appearance above described. Small retinal vessels can often be traced over the white background formed by the sclerotic. The outer border of the crescent is well defined, beyond which the fundus of the eye appears healthy.

Choroid wasted around papilla.

*Treatment.*—The abnormal condition above described may remain stationary for years, and in fact for life ; but, on the other hand, active changes may at any time occur, and we should explain this fact to our patient, informing him that if the eye begins to trouble him, if he gets an aching pain over the brow after exerting it, or if the glare of the sun is felt to be particularly dazzling and uncomfortable, the sight becoming somewhat hazy—that these symptoms indicate advancing mischief, and should be at once attended to. Supposing, however, no such complications occur, we may content ourselves with ordering the patient a pair of concave glasses to correct his myopia, and that in reading and writing he has the advantage of a good light, and is not allowed to stoop over the object he is working at.

*Treatment.*

While stationary.

Concave glasses.

2. *Progressive Form.*—The symptoms which characterize progressive posterior staphyloma are as follows :—We may notice that there is deficiency in power of the internal rectus, and the patient suffers from myopia, but he usually consults us on account of general impairment of vision, which increases after over-exerting his eyes. At such times he complains of an

2. Progressive form. Deficiency of internal rectus. Myopia.

aching pain in the orbit, extending to the temple, and also of more or less intolerance of light; the glare of the sun is trying, and induces an uncomfortable aching feeling in the eye, and photophobia. He may have suffered from repeated attacks of this kind, lasting for a month or six weeks, and then passing off, reappearing, however, after unusual exertion of the eyes, or derangement of the general health. Each attack causes the sight to become more impaired, and the myopia often increases rapidly.

Recurring attacks of pain; after work. Sight fails.

If an eye affected with this disease be examined with the ophthalmoscope in its early stages by the direct method, the fundus may appear healthy, with the exception of a portion surrounding more or less of the disc, where, usually on the outer side, a patch of choroid will be observed of a lighter grey colour than normal, the vessels of the part being congested (Plate III., Fig. 2). The alteration in the colour of this spot will be most marked near the disc; from thence, passing outwards, a number of white patches are often noticed in the choroid, these gradually coalesce into the glistening white crescent surrounding the outer part of the disc. Irregular spots of black pigment will be seen scattered over the external border of the diseased patches. In fact, in progressive posterior staphyloma, owing to the active changes which are going on in the part, the line of demarcation between the diseased and sound tissue is indistinct, and the degenerative process extends outwards, or more probably in every direction.

Alterations round papilla. Gradually shading off. No defined border.

The process appears to be essentially similar to that described as choroiditis disseminata (p. 297). As degeneration of the choroid advances the sclerotic loses its power of resisting the intra-ocular pressure, and a posterior staphyloma results. This condition having once commenced, the protrusion increases in dimensions, until it often becomes of considerable size. This, however, is by no means the only ill-effect likely to follow progressive posterior staphyloma; opacity, and fluidity of the vitreous, and detachment of the retina are unfortunately too frequently the direct result of this form of disease. The former affection will be recognized at once; on examining the eye with

Process degenerative. Often followed by fluid vitreous and detachment of retina.

the ophthalmoscope, a number of black, flocculent-looking shreds will be noticed floating in the vitreous, and will be best observed by the direct method of examination; they are to be seen whisking about in all directions upon the slightest movement of the eye, causing the patient the greatest annoyance. The state of the choroid may often be observed through the fluid vitreous even at this stage of the disease, and the history of the case indicates the nature of the affection; we should also examine the other eye, and the chances are that a posterior staphyloma will be detected in it; and thus we may be able to form a safe conjecture as to the cause of the fluid vitreous in the diseased eye.

Detached retina.

During the progress of this affection, detachment of the retina is likely to take place; for, as the staphyloma projects backwards, one of two things must occur: either the retina will be stretched and torn across in following the sinuosities of the choroid; or else, bulging backwards into the staphyloma, it will be dragged away from its attachments, either at the optic papilla or at the ora serrata. If the dioptric media are sufficiently transparent, we may watch these changes with the ophthalmoscope; frequently, however, the vitreous becomes so hazy that the retina cannot be seen, though we may be pretty well assured of its disorganized condition by the almost complete loss of vision from which the patient suffers. And lastly, secondary glaucoma may supervene at any stage of the disease. In neglected cases both eyes are sooner or later affected in this way.

*Treatment.*

*Treatment.*—It is necessary that we should do all in our power to stop the progress of the staphyloma, and the degenerative changes going on in the choroid in its early stages. If, therefore, we meet with a case presenting features such as I have described, and learn that there has been any recent aggravation of the symptoms, we should make careful inquiries regarding the patient's employment, habits, and general state of health, with a view to correcting whatever may be wrong. Overwork is almost always the exciting cause of these changes; under any circumstances we must enforce absolute rest of the eye. The

Endeavour to arrest the disease.

Promote the general health.

Enforce rest.

cold douche may often be used with advantage, morning and evening.

In addition to these general measures, if active changes are going on in the eye, apply two leeches to the temple for three consecutive nights, fomenting the part well afterwards. The patient should be kept in a dark room until symptoms of pain and intolerance of light have passed away; he may then be permitted to take exercise in the open air, wearing a pair of blue glasses when exposed to the glare of the sun or lamp-light; but he must not be allowed to resume his work until the congestion of the choroid has disappeared. Small doses of bichloride of mercury, continued for some time, are useful if inflammatory changes are advancing in the choroid.

Purgatives, leeches, low diet, in active stages.

In many instances, however, attention to the state of the general health, together with the cold douche and rest, will be the chief curative means at our disposal. By a judicious plan of treatment of this kind, the symptoms indicating active changes in the choroid will gradually subside, and the patient may then be allowed to use his eyes, though he cannot be too careful not to overwork them.

If these precautions are strictly observed, we may with confidence hope to preserve our patient's sight; taking care, whenever the uneasiness or pain in the eyes returns, to have recourse to a system similar to that above described, so as to prevent the destructive changes from making further progress. But I need hardly remark, that when degenerative changes have taken place in the choroid, retina, or vitreous, our prognosis must be guarded; we can only expect to preserve the amount of vision that exists, and not to restore that which is lost.

Treatment hopeful.

Lastly, it is above all things necessary to supply the patient with proper concave glasses, so as to correct his myopia, and thus prevent the increased convergence of the eyes which it renders necessary. As a means to this end, the patient must not attempt to read when in the recumbent position, or to write with his head bent close down over the paper. When at work he should be supplied with a sloping desk and with a good side light.

Concave glasses essential.

But more than this may be required. It has been demonstrated by Dr. Giraud-Teulon that progressive myopia is connected with insufficient action of the internal recti, and both he and Von Graefe therefore recommend tenotomy of the external rectus in cases of extreme progressive posterior staphyloma. The former learned doctor lately observing that he had then a case of extreme myopia under his care, in which intermittent strabismus had commenced, and where tenotomy of the external rectus suddenly diminished the myopia by $\frac{1}{13}$, or from $\frac{1}{6}$ to $\frac{1}{8}$ My own opinion is that the case must be a *very* extreme one before I should resort to this operation.

Tenotomy of external rectus.

## CHAPTER XI.

### DISEASES OF THE OPTIC NERVE.

*Opaque Nerve-fibres—Œdema of the Optic Papilla—Malarial, and from Hypermetropia—Hyperæmia of Papilla—Optic Neuritis—Pathology and Symptoms—Syphilitic, Nephritic and Malarial Neuro-Retinitis—Anæmia and Atrophy of Papilla—from Tobacco and Lead Poisoning; in Tabes Dorsalis.*

OPAQUE NERVE-FIBRES.*.—(Plate III., Fig. 2). We occasionally meet with cases in which the medullary sheath of the nerve-fibres, in place of terminating at the cribriform fascia, are prolonged on them into the retina. Wherever fibres of this kind exist in the retina they appear, when examined by the ophthalmoscope, as white glistening streaks or patches, according to the number and position of the opaque nerve-fibres. A condition of this kind is a congenital peculiarity, which may affect the whole circumference of the papilla and retina surrounding it, but more commonly appears in patches extending from the papilla over various parts of the retina. But whatever the form or extent of the opaque nerve-fibres, the area they occupy, especially when seen by the direct method, appears of a pure white colour, the margin of the patch presenting a finely striated appearance, somewhat resembling carded cotton wool. The retinal vessels are sometimes partly buried in the opaque fibres; occasionally they pass



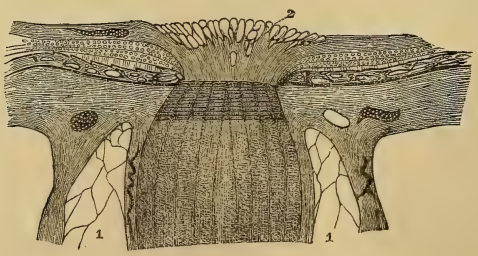
* The appearance of the healthy optic disc is described at p. 40. See also p. 14.

over its surface. Patches of this kind may be seen in one or both eyes. I have met with cases of opaque fibres complicated with optic neuritis and choroiditis, but they occur without evidence of any other abnormal condition of the fundus of the eye. The patient's sight is imperfect over that portion of the retina covered by the opaque fibres.

ŒDEMA OF PAPILLA. Pathology.

ŒDEMA OF THE OPTIC PAPILLA.—Having described the connection that exists between the sheath of the optic nerve and the arachnoid cavity (Fig. 6, p. 14), there is no necessity to refer to the subject again. But from the anatomical relation of the parts it is evident that, if the contents of the cranium are augmented by the growth of a tumour, the arachnoid fluid may be forced along the sheath of the nerve into the optic papilla. Œdema of the papilla may be produced in this way, and also by an excess of fluid in the arachnoid cavity, the intervaginal space of the optic nerve being frequently distended with serum. The fibrous stroma of the optic papilla is directly continuous with the sheath of the nerve through the lymphatic spaces. In this way we find that, if the sheath of the nerve is over-distended with serous fluid, numerous cells or cysts form in the papilla, from the pressure exercised by the effusion on the surrounding tissues (Fig. 47). It is evident, if changes of this kind can

FIG. 47.




1, 1. Intervaginal space of nerve. 2. Spaces in optic papilla filled with serum. (From Dr. A. Alt.)

be effected in the connective tissue of the papilla, that its delicate nerve elements and vessels may likewise be injuriously

pressed upon by an accumulation of serous fluid in the part. But optic neuritis is by no means a common result of serous exudation into the papilla. In cases of malarial fever, œdema of the papilla is met with independently of neuritis. For instance, T., aged thirteen, was admitted into the Calcutta Ophthalmic Hospital, on January 24. On November 9 she was attacked with quotidian intermittent fever, to which she had been subject for some years past, as well as to enlargement of the spleen. The ague continued for a week, and then disappeared under the influence of such simple remedies as she had been accustomed to employ under similar circumstances. Immediately after the fever had left her, numbness and inability to move the right arm and leg came on; the left leg on the following day was affected in the same way, so that she entirely lost the use of her lower extremities, without the existence of tingling pain or other abnormal sensations in the limbs to mark the advent or progress of the disease. As the paralysis increased she experienced advancing dimness of vision. There was no evidence of her having been affected by inherited or acquired syphilis.

Œdema in cases of ague.

*Case.*

Paralysis and loss of sight.

At the time of her admission into hospital, on January 24, she had completely lost voluntary power over her lower extremities and the right arm. The sensation in these limbs, though blunted, was not destroyed; marked reflex action existed in her legs; the muscles of the affected limbs were flaccid, and hung down precisely as though they had belonged to a dead body. The patient possessed feeble though decided voluntary power over her left arm. Her pupils were dilated and insensible to light, and she was almost completely blind, being only able to recognize the existence of a bright light held before her face in a dark room.

State on admission.

On examining the eyes with the ophthalmoscope we found the optic papilla swollen and hazy (woolly); evidently a considerable amount of serous effusion had taken place into its nervous structure, and also into that of the retina immediately surrounding the papilla; but with the exception of this œdematous state of the parts, the fundus of each eye was healthy. There was an entire absence of all other symptoms of optic

Ophthalmoscopic appearance.

neuritis or inflammation of the retina. Her voice and mental faculties were unimpaired. There was no paralysis of the muscles of her face, of respiration, or, in fact, of any part of her body, with the exception of those above indicated, nor was there evidence of disease of the heart or kidneys; her spleen was enlarged; the catamenia had appeared, and, though scanty, were regular.

*Treatment.* The patient was ordered a generous dietary, and a mixture containing strychnine, arsenic, and iodide of potassium. She continued this treatment throughout her stay in hospital.

A week after admission some improvement had taken place in her condition, and, without going into details, it may be mentioned that she gradually regained the use of her limbs, her eye-

Recovery. sight was restored, and she left the hospital absolutely cured. Within five weeks of her admission she was able to run about the ward, and count No. 1 dots at ordinary distances; the haziness of the optic papilla had entirely cleared away, and the fundus of her eyes was perfectly healthy.

Such cases common in India. This is an example of a class of cases by no means of uncommon occurrence among the natives of India, and depending apparently upon miasmatic influences affecting alterations in the blood, and thereby inducing local hyperæmia and serous effusion into various organs, in this case extending from the arachnoid along the sheath of the optic nerve to the papilla.

Pathology. The symptoms presented by our patient at the time of her

Serous effusion in the brain and optic papilla. admission into hospital pointed to serous effusion into the optic thalami and corpora striata similar to that noticed in the optic papilla, the pressure thus caused on these important nerve centres interfering with the volition of the patient over the affected limbs. Reflex action was only slightly impaired, and the patient had complete control over her bladder; the functions of respiration and deglutition were perfect, so that, as far as the trunk was concerned, she simply suffered from inability to move some of her limbs, the centres of volition, but not the will, evidently being affected. The patient, however, was absolutely blind; the pupils were widely dilated, the functions of the retina being destroyed for the time being. The ophthalmoscope showed the cause of the loss of vision, by revealing to us the existence

of extensive serous effusion into the optic papilla and retina immediately surrounding it, but there was no evidence whatever of hyperaction in the part; the circulation through the central artery and vein of the retina was unaffected; there was no hæmorrhage or indication of structural change in the part; so that we were able to form a favourable prognosis, not only as regards the recovery of vision, but also as to the paralysis. The condition of the optic papillæ, and the history of the case, lead us to conclude that the loss of voluntary power over the affected limbs depended upon a similar cause to that which induced the loss of power in the retina, and hence to arrive at the conclusion above indicated as to the seat of the effusion in the brain, and from thence into the sheath of the optic nerve and papilla. My friend, Dr. V. P. Gibney, of New York, has published the results of some very interesting cases of intermitting spinal paralysis of malarial origin. Although the presence of œdema of the papilla is not referred to in these cases, nevertheless, in some respects they are of the same character as those above referred to. Dr. Gibney remarks :—"Let me state, too, on the strength of cases that I have not reported in this paper, because they were not intermittent, or relapsing, if this term be preferable, that there may be spinal paralysis affecting one side or a single member, clearly traceable to malarial poisoning. They are not numerous, however, and the history will generally enable one to exclude a polio-myelitis anterior. If nervous diseases are increasing, as many authorities claim, may we not expect to find the cerebro-spinal axis the more readily and the more frequently influenced by malarial poisoning, just as we find now the nerves so commonly affected?"

The ophthalmoscope an aid to diagnosis.

I have met with cases of serous effusion into the optic papilla among young women suffering from amenorrhæa and other menstrual disorders. In instances of this kind the patient usually complains of headache and impaired sight, which increases periodically, and on examining the eye distinct evidence of effusion into the optic papilla may be detected. Cases of this description are to be treated rather with reference to the state of the patient's general health than to the condition of the optic disc.

Serous effusion in amenorrhœa.

Hyperæmia of Papilla.

Hyperæmia of the Optic Papilla is characterized by the papilla assuming a bright scarlet colour and velvety appearance, with a slight amount of effusion, so that its outline is somewhat obscured, especially its choroidal border. The colour of the healthy papilla varies, however, in different individuals, and even in the same person under various circumstances; the bright light thrown into the eye by the ophthalmoscope is probably sufficient to excite increased vascularity. It follows, therefore, that it requires considerable experience to enable us to determine if hyperæmia is present or otherwise. However, there can hardly be a mistake in those cases in which the disc is of a persistent bright rose colour, which is frequently met with among patients who strain their eyes to overcome some error of refraction from which they are suffering. Dimness of sight, headache after work, and pain in the back of the eye are symptoms often complained of in cases of this description. A condition of marked hyperæmia, and occasionally of serous effusion into the papilla, is also occasionally met with among girls suffering from menstrual troubles; or it may depend upon disorders of the alimentary canal. In some instances I have thought that the irritation caused by decayed teeth in the upper jaw has led to persistent congestion of the papilla. Whether from errors of refraction, or whatever the cause of the hyperæmia, it must be rectified, if possible, and the affected eye kept at rest for a time. Persistent hyperæmia borders so closely upon papillitis that the line of demarcation between the two conditions is often very slight, and demands careful attention.

*Symptoms.*

Optic Neuritis.

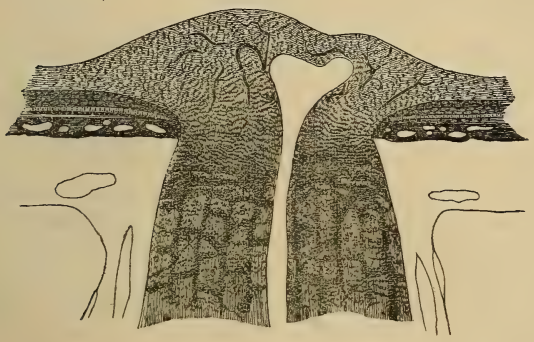
Optic Neuritis.—Considering the intimate relations that exist between the brain and the optic papilla, we shall be prepared to accept the statement that ninety per cent. of cases of bilateral neuritis are the result of disease of the encephalon. On the other hand, the nerve-elements of the papilla and its connective fibres being prolonged into the retina, it follows that neuritis can hardly exist for any length of time without compromising the integrity of the retina.

Pathologically, optic neuritis may be divided into three classes:—(1) Interstitial; (2) Fibrinous and Purulent; (3) Me-

dullary. But as it is doubtful if inflammation ever commences in, or is confined to, the purely nerve elements, I shall not attempt to describe "medullary optic neuritis."

*Interstitial Optic Neuritis*, from a pathological point of view, is the most frequent form of inflammation affecting the optic nerve. It is essentially a disease of the neuroglia and interstitial connective tissue of the nerve. The connective tissue trabeculæ separating the bundles of the nerve are found crowded with lymphoid cells. The optic papilla is much swollen, and contains numerous newly-formed bloodvessels, Pathology.

FIG. 48.



From Dr. A. Alt.

and frequently spots of blood (Fig. 48). The vessels of the optic nerve are surrounded by layers of round cells. But the nerve-fibres are only slightly affected, unless in the advanced stages of the disease, when they undergo fatty degeneration. As the new cell-elements become developed the trabeculæ increase in thickness, and at the same time the vessels are compressed, and ultimately dwindle away to fibrous cords. It often happens that first one part of the nerve and then another is affected in this way. Changes in the elements of the papilla occur precisely similar to those in the nerve. The retina becomes thin and in the later stages of the disease peri-vasculitis and interstitial retinitis are observed.

*Fibrinous and Purulent Neuritis* depend on an extension of FIBRINOUS NEURITIS.

similar forms of inflammation from one or other of the meninges of the brain. There is congestion of the vessels contained in the sheath of the optic nerve. The intervaginal spaces or sheath of the nerve is distended with serous fluid. Rapid proliferation of the endothelial cells takes place, and the lymph spaces soon become occupied by connective tissue, so that the intervaginal spaces are obliterated. During these changes the optic papilla is intensely congested, hæmorrhages are frequently found among its elements; its connective tissue becomes hypertrophied, and the nerve elements disappear.

Pathology.

The purulent form of neuritis is comparatively rare, and is caused by an extension of suppurative meningitis to the optic nerve.

The results of the various forms of optic neuritis, in addition to the dangers already referred to, are atrophy of the papilla and alterations in the retina. Inwards from the hypertrophied lamina cribrosa, the nerve elements of the papilla often become atrophied, but can usually be distinguished from the surrounding connective tissue, unless in advanced cases, when the disc is converted into a net-work of areolar tissue, the meshes of which are empty; as this connective tissue contracts, and the nerve structure disappears, atrophic excavation of the optic papilla ensues. So that in some specimens we find the elements forming the papilla have entirely been removed and the optic disc is formed by the hypertrophied trabeculæ of the lamina cribrosa; the vessels of the disc and retina have almost disappeared, and atrophy of the nerve-fibre layers of the retina is marked.

Atrophy of papilla in neuritis.

The vitreous body in proximity to an inflamed papilla often becomes infiltrated with round cells, which, as they grow, form a nodule of connective tissue projecting into the vitreous chamber. New tissue thus produced occasionally fills in the excavation otherwise found in the atrophied optic papilla.

Changes in vitreous.

*Symptoms of Neuritis.*—In the early stages of optic neuritis, if the eye is examined by the direct ophthalmoscopic method, the disc will be seen of a rose-red colour; it is swollen and cloudy from effusion, so that its margin is more or less indistinct, but by the indirect method this cloudiness may not be

Symptoms of neuritis.

perceptible. If the neuritis continues, the red tint of the papilla becomes deeper, or it assumes a reddish-grey tint. The swelling increases, so that there is an evident displacement of parts in lateral or vertical movements of the ophthalmoscope. The periphery of the swollen disc is striated, in consequence of the opaque condition of the inflamed connective tissue and the engorged vessels that pass between the swollen fibres. This striated condition of the periphery of the disc passes gradually into the tint of the surrounding retina; but the centre of the disc is of a uniform greyish, or it may be dark red colour (Plate II. Fig. 1).

These changes in the papilla may be more marked in one part of the disc than another, so that the edge of the disc may be clearly defined, perhaps on the temporal side, while the nasal side of the papilla is completely obscured by opaque tissue.

Hæmorrhages are frequent in this stage of neuritis; they occur sometimes on the surface, or beyond the edge of the disc. White lines and spots are not uncommon. The arteries are not much altered in cases of slight neuritis. The veins appear dark as they pass down the sides of the central swelling, and are at times dilated from pressure. As the neuritis increases these symptoms are augmented; the swelling of the disc is very marked. The veins are engorged with blood, and the vessels as they cross the disc are often obscured in its swollen and opaque tissue. The central depression in some cases is very marked, in consequence of the neuritis being chiefly confined to the periphery of the disc, in other cases the engorged tissues extend further over the retina. It often happens that symptoms such as those described gradually pass away, and the disc resumes its natural condition.

Hæmorrhage.

Advancing neuritis.

Improving.

Supposing, however, that the inflammatory symptoms increase, we then find that the swollen papilla becomes more prominent, and extends further over the retina. Symptoms of strangulation of the retinal vessels become conspicuous; the arteries are much narrowed, and frequently concealed by the inflammatory swelling. The veins are likewise buried in the exudation, and immediately beyond the swelling appear greatly distended; they are often remarkably tortuous, and even assume a cork-

Increasing Neuritis.

*Symptoms.*

screw form in consequence of their elongation. The swollen disc is of a dark red colour, and striated by the engorged vessels and extravasated blood. Hæmorrhages of large size may generally be seen scattered over the fundus of the eye. After a severe attack of neuritis the disc in the greater number of cases gradually clears, its vessels, especially the arteries and those of the retina are much contracted, the disc assuming a greyish-white appearance. The outline of the disc is often blurred, and bordered in places by black pigment. In some cases we notice a narrow zone of atrophied choroid surrounding the disc to a greater or less extent; this zone occasionally assumes somewhat the appearance of a narrow posterior staphyloma, and is usually bounded externally by a band of black pigment. In advanced cases the optic disc is excavated, a condition only to be thoroughly appreciated by means of the direct method of examination.

Atrophy of disc.

Patients suffering from optic neuritis often complain of loss of sight, but the ophthalmoscopic indications are not a safe guide as to the extent of impairment of sight. It sometimes happens that with the appearance of well-developed neuritis a patient can see fairly well. On the other hand, in some instances of only slight engorgement of the vessels of the papilla, and faint œdema of the disc, the patient will have almost lost all perception of light. In the same way, it is unsafe, simply from the appearance of the papilla, which may seem to be atrophied, to judge of the amount of vision which a patient possesses. In many instances of neuritis there is marked diminution in the extent of the visual field, depending on atrophy of the outer part of the retina. In other cases central scotoma may exist with loss of colour-vision. The field of vision demands careful consideration in all instances of neuritis and atrophy of the papilla.

Condition of vision in neuritis.

In cases of neuritis the state of the pupil is uncertain. The patient often complains of coloured spots or streaks in the field of vision; and has more or less completely lost the colour-sense. Imperfect memory, giddiness, unmeaning vomiting and constipation, with pronounced paroxysmal attacks of violent pain in the head, point to cerebral mischief. A careful inquiry must be made regarding any evidence of acquired or hereditary

Colour-sense imperfect.

syphilis; and the condition of the urine with reference to the presence of albumen or sugar are points never to be neglected when examining patients suffering from optic neuritis. In other cases there may be symptoms indicating the existence of a tumour in the orbit (p. 57), or of previous cellulitis.

Causes of neuritis.

*Causes.*—It is beyond my province in a work of this kind fully to enter on a discussion of the causes of optic neuritis. The truth is, that the majority of these cases belong more strictly to the physician than to the surgeon. Nevertheless, we are so constantly consulted by patients suffering from impaired vision depending upon neuritis, that it is necessary we should be able to form an opinion as to the meaning of this symptom in the various cases that come under our notice.

From œdema not frequent.

I have seen so many instances of œdema of the optic nerve accompanied with total loss of sight during the existence of the effusion, but which have ultimately recovered, that I cannot think pressure upon the nerve from serous effusion is a frequent cause of neuritis. In confirmation of this idea it may be mentioned that the presence of a tumour in the orbit pressing upon the optic nerve, by no means invariably induces symptoms of papillitis. On the other hand, inflammation of the cellular tissue of the orbit frequently leads to papillitis, the inflammatory action extending to the optic nerve. From these facts we shall be prepared to concur in the idea, that in instances of tumours of the brain, neuritis is not caused by the pressure exercised by the morbid growth on the contents of the skull, but that in all probability the neuritis is the result of central irritation extending along the course of the nerve to the papilla.

Frequently extends from brain.

Brain symptoms.

The existence of severe headache, and other symptoms to which I have referred, point to the fact that gummata and other growths within the skull at times excite irritation. And we have strong evidence against serous effusion being a cause of neuritis, so that we naturally fall back upon the theory above referred to as the cause of the majority of instances of bilateral papillitis.

From sympathetic irritation.

At the same time, it must be admitted that neuritis may be caused by sympathetic irritation. The distinction between neuritis the result of inflammation extending from a diseased

Causes of neuritis.

centre, and that induced by sympathetic irritation, may be best explained by referring to cases of injury to the eyeball. My colleague, Mr. Juler, has shown me some very beautiful preparations demonstrating the fact that, in instances of injured eyes removed to avert cyclitis in the sound eye, there is evidence of well-marked interstitial neuritis in the optic nerve of the excised globe. In speaking of cyclitis occurring in the second eye after injury to the other one, I stated that in many such cases, if examined sufficiently early, papillitis might be detected. Neuritis of this kind is in all probability caused by a direct propagation of the inflammatory action excited in the optic nerve of the injured eye to the sound one. Most surgeons must be aware of the fact that, shortly after excising a diseased globe, the sight of the other eye often becomes hazy, a condition, I think, produced by the irritation caused by the division of one optic nerve propagated directed to the other papilla. These are instances of inflammation directly passing from an inflamed area along the course of the optic track, and are in many respects analogous to the papillitis which is frequently met with in cases of cellulitis of the orbit.

Sympathetic Neuritis.

On the other hand, these facts by no means explain the circumstances attending cyclitis in a sound eye, the result of an injury to the other eye. There can be hardly any question as to cases of this kind depending upon sympathetic irritation of the injured ciliary nerves; and we have evidence tending strongly in favour of the idea that irritation of a distant nerve may induce neuritis, and consequent atrophy of the optic disc. I allude to cases of wounds involving the supra-orbital nerve. I have a case of this description now under observation in which a patient received an incised wound over the inner part of the right eyebrow and forehead. For some weeks after the accident no impairment of vision in the corresponding eye was observed; the patient then gradually lost the sight of the eye. When first I saw him well-marked papillitis existed, and has terminated in atrophy of the disc. In this case, as cicatrization of the wound in the forehead was completed, doubtless some of the fibres of the supra-orbital nerve became involved, and by sympathetic action caused the neuritis (p. 79). I have seen

several cases of this kind, and they confirm me in the opinion that neuritis may result, not only from the direct extension of inflammation from a diseased area along the course of the optic nerve, but also from sympathetic irritation.

*Symptoms.* *Symptoms.*—Whatever may be the cause of neuritis, we can only diagnose the existence of this condition by means of the ophthalmoscope. But although we can readily demonstrate the existence of the lesion, we are unable from the appearance presented by the papilla to determine the nature of the cause which has given rise to inflammation of the disc. The determining cause of the neuritis must be arrived at from a consideration of the symptoms from which the patient suffers. Among the causes, I may refer to malaria, syphilis, tabes dorsalis, and various poisons, such as tobacco and lead, which appear to excite inflammatory action in the elements forming the papilla.

Malarial Neuro-Retinitis. Malarial Neuro-Retinitis.—The following case illustrates the circumstances of neuro-retinitis resulting from malarial fever. H., aged twenty-four, having served with his regiment at Peshawur, was ordered to Cabul. He had suffered from an attack of remittent fever and from repeated "fits of ague." On his return from Afghanistan, while on the march to Meerut, he noticed one morning that everything appeared dim before him; towards evening he saw better, but next day, after an attack of ague, his sight became so much worse that he had to discontinue military duty. At this time he was seen by Surgeon-Major Maxwell, who reported that Mr. H. "had neuro-retinitis of the left eye of an extensive nature, and less so in the right eye. The left optic disc was indistinct and congested, the vessels engorged and tortuous, bending over the swollen portion of the retina. The vessels were in some places concealed by the swelling of the retina. The right eye presented signs of disease similar to the left. He was already quite blind; pupils dilated, very inactive. H. has had constant attacks of malarial fever, and has enlargement of his spleen; otherwise his health has been good. There is no suspicion of syphilis." At the time of this report drawings were made of the condition of H.'s eyes, and are characteristic of neuro-retinitis in both eyes, with white

spots near the macula lutea, the result of previous hæmorrhages into the left retina. I saw this patient on his arrival in England, three months after the commencement of the affection of his eyes above referred to. He had then been free from ague for two months; his spleen was still enlarged; there was no albumen in his urine. The symptoms of neuro-retinitis were well-marked in the left eye, and also the white patches and small filiform hæmorrhages near the yellow spot. In the right eye the papilla had commenced to show itself from behind the inflammatory effusion. At this time the sight in both eyes at twenty feet was *nil*, but at eight inches the patient could make out No. 6 of Snellen with the right eye; with the left he could only count fingers. Full doses of liquor arsenicalis were prescribed, and the patient sent to a healthy part of the country. The symptoms of neuro-retinitis entirely passed away, the spleen resumed its normal size, and the patient entirely recovered his sight, and was able to resume his military duties within a year's time of his arrival in England.

I have now seen a considerable number of cases of this kind, in which the symptoms of neuro-retinitis have been so directly associated with malaria that they certainly seem to depend upon a common cause. I may refer to the remarks already made respecting œdema of the papilla the result of malaria as confirming this idea, and illustrating the method of treatment to be adopted in such cases (p. 319).

Anæmia and optic neuritis.

*Anæmia.*—Optic neuritis is not uncommon in girls suffering from chlorosis; and the papillitis rapidly disappears under the influence of iron. It is quite possible, therefore, that malaria, by causing alterations in the general blood state, may lead to optic neuritis.

Syphilitic Neuro-Retinitis.

Syphilitic Neuro-Retinitis (Plate II., Fig. II.).—The presence of this form of disease is determined more from the previous history of the case than from characteristic appearances presented by the lesion, and, as we might naturally have expected, is frequently complicated by diseases of the choroid and iris. In the choroid, under these circumstances, we notice that the pigment-cells become heaped into small masses, present-

Complications; Choroidal;

ing, when examined by the ophthalmoscope, the appearance of greyish or dark dots and patches. At the same time the vitreous undergoes degeneration; it becomes clouded, fluid, and occupied by dark flakes, thus shrouding the retina from our view, sometimes rendering the changes going on in the optic disc and parts around obscure. Vitreous.

Syphilitic neuro-retinitis commences with hyperæmia of the disc and venous congestion of the retina, the arteries being diminished in calibre; and the papilla soon becomes obscured by a cloud of effusion. The course of the retinal vessels is frequently marked by a greyish film, which runs along the outside of the vessels, gradually shading off into the healthy retina. The optic disc is swollen and hazy, the haziness extending beyond its circumference to a variable distance over the retina. This greyish film on the retina is seldom uniform; but as in syphilitic keratitis, so in retinitis, one part of the affected structure is usually more hazy than another. This is often particularly the case near the axis of vision, where small punctiform opacities of the retina are noticed in syphilitic inflammation of this structure: and these opaque spots undergo rapid alterations, often disappearing in the course of a few days. Ophthalmoscopic appearances. Film round vessels. Optic disc hazy. Patches in retina.

If the abnormal action continues unchecked, further changes in the retina become developed, for as the exudation becomes organized the tissues involved grow opaque, and the nerve structure of the retina is destroyed, a white glistening patch appearing in the place of the originally inflamed tissue. The vessels passing to and from the inflamed patch may be slightly congested, but this is by no means a constant appearance; the bloodvessels can seldom be traced through the inflamed area, as the tissue, in the act of becoming organized, contracts and obliterates them. Hæmorrhages are not of common occurrence in this form of retinitis. Hæmorrhage not common.

*Symptoms.* Syphilitic neuro-retinitis, as I have above remarked, is in many cases preceded by iritis and irido-choroiditis, so that we may expect to meet with evidence of pre-existing mischief in these structures; nevertheless, this is not always the case, for instances undoubtedly occur in which constitutional syphilis being present, the poison selects the papilla and retina as the

first structure for attack in the eye. Under any circumstances syphilitic neuro-retinitis having commenced, the patient complains principally of impairment of vision, it may be in one or both eyes; the diminution of sight may be sudden or may creep on very slowly; it not uncommonly has periods of amendment, and then becomes worse than ever again. The field of vision presents spots of almost total blindness, other parts being comparatively normal; evidently dependent upon the disposition of the diseased action to affect some part of the nervous tissue of the retina at one time, more intensely than at another, thus altering the state of the visual field from time to time. When sclerosis of any part of the retina has been completely established, and the nervous and vascular tissues destroyed, this spot remains as a black patch in the visual field. The general dimness of sight is in most instances increased by the changes already noticed as common in the vitreous in cases of this kind.

Dimness of Vision.

Visual field unequally impaired.

*Prognosis.*—The prognosis of this form of neuro-retinitis depends very much upon the stage of the disease when first brought under our observation. If we discover no great changes in the retina or choroid our prognosis may be favourable, even to the hope of restoring sight. But the disease being a constitutional one is apt to recur, and we must caution our patient accordingly, impressing on him the necessity of applying to us the instant he discovers any retrogression in his power of sight. When once dense opaque patches have formed in the retina I need hardly say we can entertain no hope of the corresponding portion of the nerve regaining its functions.

*Prognosis.*

*Treatment.*—I would refer the reader to the remarks I have already made regarding the treatment of syphilitic iritis; a long-continued and carefully managed course of mercury is, I am convinced, the correct treatment for cases of this description. Like most other practitioners, I have had my seasons of doubt as to the necessity for administering mercury for the relief of syphilis, and although I still believe it is impossible in all cases to *cure* syphilis, nevertheless I am equally sure we may generally destroy the passing effect of syphilis on the tissues of the body by means of mercury, and in few instances are the

*Treatment.*

curative effects of this drug more marked than in cases of syphilitic retinitis.

INHERITED SYPHILITIC NEURO-RETINITIS generally comes on in infancy, and, unfortunately, there are no external symptoms to mark the progress, or even the existence, of this formidable disease; and it is only as the child grows older that his vision is discovered to be defective. He is then, perhaps, supposed to be short-sighted, or to have some affection of the eyes depending on dentition, which it is hoped he will outgrow; whereas the disease, if its real nature were recognized and judiciously treated, might very possibly be alleviated, and the sight saved. The importance of making an ophthalmoscopic examination in a case of imperfect vision among young children cannot be too strongly enforced. Should patches of syphilitic inflammation exist in the eye, we must at once resort to the treatment I have recommended in cases of similar affections of the iris—namely, mercurial inunction, or the administration of the iodide of mercury, together with tonics.

Inherited Syphilitic Retinitis comes on in infancy.

Often not recognized.

*Nephritic* neuro-retinitis, met with in Bright's disease, is a subject to which I shall return when considering affections of the retina, because in not a few cases of the kind neuritis is far less a feature of the disease than the changes observed in the retina. As Dr. Gowers, however, remarks, in some cases the inflammation of the optic nerve predominates over the other retinal changes, to such an extent that it may appear to be the only alteration, and may present exactly the same aspect which is common to papillitis, the result of intra-cranial disease. A careful examination will show, in almost all cases, signs of retinal degeneration; it may be only a few white spots in the retina. Small hæmorrhages are also frequently seen, and in many cases white patches and filiform hæmorrhages.

Neuro-retinitis in Bright's disease.

## ATROPHY OF THE OPTIC PAPILLA.

(Fig. III., Plate 1).—It not unfrequently happens that, after the optic papilla has been inflamed, the haziness and other symptoms of neuritis gradually pass away, and the disc assumes almost its normal appearance. But in the greater number of such cases the

Atrophy after neuritis.

exudation in and about the inflamed disc becomes more or less organized, and the consequence is, from the pressure exercised by the organized tissue on the vessels and nerve of the papilla, they become atrophied.

Under these circumstances, we frequently find that the disc assumes an opaque white or bluish-green appearance. The margin of the disc is blurred and irregular, and often marked by a deposit of black choroidal pigment. The retinal artery is generally diminished in calibre ; the veins may remain more or less tortuous ; but there are many exceptions to this condition of the vessels. But in pronounced cases of atrophy of the papilla its opaque white appearance is characteristic. In advanced atrophy the papilla is usually excavated, a condition I shall refer to under the head of glaucoma.

It is almost unnecessary to remark that an atrophied papilla is a permanent condition, and is uninfluenced by treatment.

Atrophy of disc from tobacco.

TOBACCO AMAUROSIS, OR ATROPHY OF THE PAPILLA.—Among the various causes which give rise to atrophy of the papilla, I must refer to the effects of excessive tobacco smoking, too often combined with excessive drinking. I formerly had some doubts in my mind as to the supposed deleterious influence which tobacco and alcohol, either combined or separately, have upon the optic nerve. But I have no hesitation now in affirming, with Dr. David Webster, of New York, "that the abuse of alcohol alone, or of alcohol and tobacco combined, may produce impairment of vision ranging from the slightest blurring to total blindness." The following are the characteristic symptoms of this form of disease :—

Sight impaired.

The patient usually finds that his sight has become somewhat suddenly enfeebled. The acuteness of vision is sensibly diminished, the patients perhaps being scarcely able to read Nos. 8 or 10 test types, while in some cases they cannot distinguish even the largest type. A sort of white haze seems to envelop every object, and improvement generally takes place towards evening or on dull days, the haze then being less apparent. The perversion of the chromatic faculty is marked. Yellow, red and green are often confounded with each other. Th

Day and colour blindness.

patients frequently see double or triple, probably on account of spasmodic contractions of the muscles of the eye. The pupils are not alike in the two eyes, one being generally larger than the other, and often irregular. No other alteration is observed in the exterior of the eyes. Ophthalmoscopic examination in early stages of this affection often demonstrates serous suffusion, especially in the vicinity of the vessels. The arteries in some places exhibit spasmodic contractions, while the veins are tortuous and gorged. This disposition is observed to be more marked as the disease becomes prolonged, and then the papilla of the optic nerve is pale and whitened. De Wecker, however, states that he has never seen general pallor of the disc leading to atrophy in these cases.

Double Vision.

Ophthalmoscopic signs.

From the above statement of symptoms, it appears that tobacco and alcoholic amblyopia is an affection of the eye apart from atrophy of the papilla from other causes, such as neuritis or tabes. Tobacco amaurosis may even be completely cured, to return again after renewed excesses in drinking and smoking.

*Diagnosis.*

With respect to the pathology of this form of atrophy of the papilla, M. Galezowski says that "it is due to a kind of paresis of the longitudinal muscular fibres of the arteries, which act in dilating them, and to a spasmodic contraction of the circular fibres of these same vessels. The blood does not arrive in a sufficient quantity for the arteries, while the veins undergo a kind of passive stasis." In conformity with this view, a collyrium of eserine has been employed as a means of inducing relaxation of the spasmodic contraction of the arteries. The efficacy of this agent is incontestable, for the patients are sometimes immediately relieved, seeing better during the whole period that its action continues, while its daily use leads to a sensible amelioration. In many of the cases large doses of bromide of potassium have produced sensible amelioration.

Pathology.

*Treatment.*

To sum up:—1. The disease appears as a consequence of prolonged indulgence in tobacco and alcohol, and especially when the latter is taken fasting or before dinner. 2. Bad food and a wretched condition of existence predispose to its development. 3. Complete abstinence from alcoholic drinks and tobacco during several weeks or months is an indispensable

Summary.

condition for recovery. 4. The bromide of potassium is a very efficacious remedy : and the eserine collyrium is one of the best means of combating the visual disturbance. 5. This form of atrophy is tractable when treated at an early period ; but later it becomes a serious affection, which cannot be relieved.

Plumbic Neuritis.

PLUMBIC ATROPHY OF THE OPTIC PAPILLA. — Patients labouring under the influence of lead poisoning, occasionally suffer from optic neuritis. Amongst the ophthalmoscopic features of plumbic neuritis we may mention the small amount of exudation usually present, and the early and great diminution in size of the arteria and vena centralis. The choroid does not appear to be in the least implicated. These cases of plumbic neuritis would appear generally to lead to complete blindness.

Another form.

In another class of these cases the optic neuritis commences with hyperæmia of the disc and retina, followed by partial haziness of the disc, extending some little distance over the retina. The disc, or rather the outer part of it, as a general rule, becomes pale and atrophied, the inner half retaining its normal appearance.

Atrophy of disc in tabes.

ATROPHY OF DISC IN TABES DORSALIS.—My friend Dr. Buzzard insists upon the importance to be attached to a recognition of the changes that occur in the optic disc in cases of tabes. The more carefully these changes are studied, the more frequently will they be found in that numerous class of ill-defined cases of atrophy of the optic disc which come under the cognizance of ophthalmic surgeons. A patient applies to us complaining of dimness of sight; on examining his eyes we find that his optic discs are of an opaque white or bluish-green appearance, the retinal vessels frequently being undiminished in size. Under these circumstances we should invariably turn our attention to the existence or otherwise of symptoms of tabes. In many of these cases we shall find that the patient's pupils are extremely contracted, and do not respond to the stimulus of light, we then apply the Argyll-Robertson test. This test consists in making the patient look intently at an object held close in front of his nose. An inordinate power of accommodation

Frequency of tabes.

Pupil test.

being thus called into play, supposing tabes exists the pupils frequently contract, but the instant the patient looks at a distant object they resume their former calibre, and do not respond to the stimulus of light.

Dr. Buzzard recommends the ophthalmoscope as a convenient mode of using this test. The patient should be directed to look over your shoulder at some object in the distance. With the ophthalmoscopic mirror you then cast a strong light upon his eye, while at the same time you watch through a convex lens for any variation in the size of the pupil. Supposing that the pupil does not contract to light, the patient may next be told to look alternately at a distant object, and at one almost in a line with it, but within a short distance of his eye. Uniform illumination of the surface of the eye should be maintained during the continuance of the examination, and the diameter of the pupil watched as the patient's gaze is shifted from a distant to a near object.* Ophthalmoscope.

Dr. Buzzard explains this symptom in cases of tabes, by reference to the fact that the movements of the iris are of two kinds, reflex and voluntary. Reflex action is exhibited as constriction of the pupil in consequence of the stimulus of incident light upon the retina. It is this reflex movement which is so frequently impaired in cases of tabes. The contraction of the pupil which accompanies that of accommodation for near objects is a voluntary action, and is unimpaired in a large number of cases of tabes.

It is almost unnecessary to remark, that hardly a day passes in the out-patient department of an ophthalmic hospital without meeting with cases of impaired vision, which on ophthalmoscopic examination reveal to us an opaque white or bluish disc with a clear and sharply cut outline; and in many of these cases the vessels are undiminished in size. Dr. Buzzard is disposed to think that this condition of the disc is due to sclerosis, and differs from the atrophy consequent on neuritis in that the latter is frequently marked by traces of effusion about the disc, the edges Neuritis in early stages of tabes.

* "Clinical Lectures on Diseases of the Nervous System," by T. Buzzard, M.D., p. 138. Churchill, 1882.

of which are blurred. After neuritis the central artery is often diminished in calibre, and the veins may retain more or less of the tortuosity by which they are characterized when the disc is swollen. I am inclined, however, to the opinion that in many cases of tabes, if examined before atrophy of the disc has taken place, a swollen and inflamed condition of the papilla will be found. I am certain that I have seen instances of neuritis in which well-developed symptoms of tabes existed, and which have ultimately passed on into a condition of atrophy such as that described above by Dr. Buzzard as characteristic of tabes. Moreover, in cases of tobacco, lead, and malarial atrophy of the disc, we frequently see the vessels undiminished in size, and appearing as if applied against an opaque white disc with a sharply defined outline.

I have already stated that it is impossible for us by means of the ophthalmoscope to determine from the appearances presented by an inflamed optic disc the cause which has produced the papillitis. And I believe it is equally impossible for us to determine from the appearances presented by an atrophied disc the pathological changes which have led to this condition. But if with impaired sight we find atrophy of the disc and the Argyll-Robertson pupil, it is most probable that tabes is the disease from which the patient suffers. The diagnosis is confirmed if the patient has lightning pains, want of patellar reflex action, paralysis of one or more of the ocular muscles, or the peculiar gait of tabes. Dr. Buzzard insists forcibly on the fact that in instances of tabes intense pain in the head is not an uncommon symptom, suggestive, as he remarks, of the presence of an intra-cranial tumour.* The pathological conditions leading to sclerosis are obscure, but these paroxysms of pain, as in cases of cerebral tumours, point to irritation of an inflammatory nature. And if so, we might expect to find papillitis preceding atrophy of the disc in instances of tabes.

*Symptoms.*

* "Clinical Lectures on Diseases of the Nervous System," by T. Buzzard, M.D., p. 147.

## CHAPTER XII.

### *Excavation of Optic Disc—Glaucoma—Pathology—Symptoms—Treatment.*

BEFORE entering upon the subject of glaucoma it is necessary to make a few remarks upon the excavation of the optic disc, which so constantly attends this form of disease. And further, to observe that the term glaucoma includes a series of symptoms which may be produced by various causes.

EXCAVATION OF THE OPTIC NERVE.—In this condition of the papilla, if the direct ophthalmoscopic method be employed, and the vessels at the margin of the excavated disc are accurately kept in focus, their continuation over the papilla cannot be distinctly seen till the accommodation of the observer's eye is altered, the vessels on the disc being on a plane posterior to those of the retina. By the indirect method, in deep cupping of the optic disc, the floor of the pit can be seen below the level of the fundus by moving the objective lens slightly from side to side. The margin of the disc will move in the same direction as the lens, at a greater rate than the floor of the disc, and will present the appearance of actually moving to and fro over it.*

Excavation of Optic Nerve. Ophthalmoscopic examination. Direct method. Indirect method of examination.

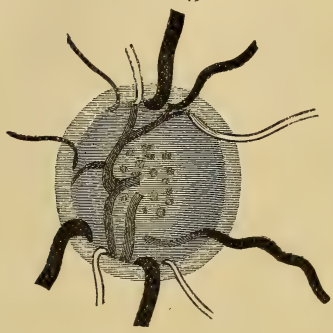
*Causes.*—Excavation of the optic nerve may arise from various causes; and first, from glaucoma, or pressure excavation;

* "How to Use the Ophthalmoscope," by Edgar Brown, Surgeon to the Liverpool Eye Infirmary, p. 86.

secondly, from congenital malformation; thirdly, from atrophy of the optic nerve.

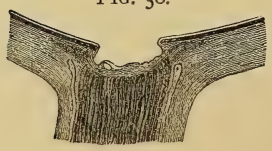
1. Excavation of papilla in glaucoma.

FIG. 49.



1. In glaucomatous excavation, the whole of the disc is involved, and its sides are always steep, sometimes even overhanging; this condition of the parts is shown in section in Fig. 50. The vessels may be seen at the margin of the disc, terminating as it were in hook-shaped extremities. They seem to pass from the fundus of the eye up to the margin of the disc, and then suddenly to disappear; isolated portions of them can be seen towards the centre of the disc, dim and out of focus (Fig. 49). The colour of the optic disc is changed to a bluish or greenish-grey or white colour, and it is surrounded by a white halo of partially exposed sclerotic. It is important to remember that in cases of glaucoma not only is the disc excavated, but, from intra-ocular pressure, atrophy of the optic nerve is as constant a pathological condition.

FIG. 50.



2. In congenital malformations.

2. In cases of excavation of the papilla arising from congenital malformation, the whole of the disc is seldom involved; but I have seen congenital cases in which the entire disc was cupped, with the exception of a narrow border at its circumference; so that its choroidal edge was normal, and within this was a rim of the papilla, the remainder of it being excavated. But these cases are rare, compared with the number of congenital cases in which only a comparatively small portion of the disc is involved in the excavation. The depression of the optic disc under these circumstances is surrounded by a reddish zone, and

the edges of the cup are usually slightly sloping. With the exception of the excavation of a portion of the disc, the fundus of the eye is healthy, and its tension normal. Malformations of this description do not necessarily give rise to any subsequent changes in the eye.

3. Lastly, excavation of the disc arising from atrophy and retraction of the optic nerve is marked by atrophy of the elements of the optic nerve so that the colour of the papilla is changed to a greyish-white tint. In the atrophic form of excavation there is a comparatively slight amount of depression of the papilla, its sides sloping down gradually from the circumference towards its centre. The vessels may therefore usually be traced throughout their extent; but when the branches coursing over the fundus of the eye are in focus, those passing over the disc will appear slightly out of focus, until the accommodation of the observer's eye is altered; cupping of the optic disc due to atrophic excavation can only be made out well by means of the direct method of examination. 3. In atrophy of papilla.

GLAUCOMA.—We may proceed to consider the subject of glaucoma under three heads :—1. Glaucoma. 2. Glaucoma simplex. 3. Secondary glaucoma.* GLAUCOMA.

1. *Glaucoma.*—In this form of disease the morbid phenomena depend, according to Professors Stellwag von Carion and Donders, on neurosis of the vaso-motor nerves of the eye and hardening of the sclerotic; which latter condition they suppose may lead to diminished exhalation or transudation of serous fluid from the globe of the eye. Pathology.

Section of the fifth pair of nerves causes excessive softness of the globe of the eye, and, on the other hand, excitation of these nerves causes an augmentation in the amount of serous fluid contained in the vitreous, and so increases the intra-ocular tension. Supposing, therefore, that excitation of the fifth nerve Increased vitreous from neurosis.

* Acute glaucoma—glaucoma fulminans—from a clinical point of view, is better considered under the heading of serous choroiditis. It differs so completely in its symptoms from those cases of glaucoma which we so constantly meet with in practice, that it seems to me rather misleading to describe it under this heading.

Pathology. occurs, and the quantity of serous fluid contained in the vitreous is increased, if the tissues of the eye at times undergo senile hardening, these conditions, either singly or combined, might lead to increased intra-ocular pressure.* The injection of a few drops of fluid into the choroid or vitreous causes the globe of the eye to become of stony hardness. It is this fact which strongly influences my ideas regarding the pathology of glaucoma, and which best explain the symptoms of acute serous choroiditis (p. 302). And when we consider that the lymphatics and veins of the choroid and ciliary body leave the eye by means of a few large branches, which pierce the sclerotic obliquely, we can understand, if abnormal innervation of the vessels constituting the vascular layers of the choroid leads to rapid serous effusion within the outer casing of the eye, that the pressure outwards exercised by the excess of fluid within the eyeball must compress the veins and lymphatics against the sclerotic as they pass through it. When distension of the eyeball is thus once produced, it tends to maintain and to increase itself, and so excessive tension of the globe is established, and its weakest part, the optic disc, is thrust backwards. That nerve influences have much to do with certain cases of glaucoma seems evident from the number of cases, especially among people under forty-five years of age, who attribute their impaired sight to intense anxiety, or to disorders—it may be over-indulgence—of the grosser passions.

Dr. Priestley Smith argues that glaucoma may depend upon either an increasing size of the lens (senile), or upon any affection of the ciliary body by which the circumlental space is diminished, so that the passage of fluid from the vitreous to the aqueous chamber is interfered with, and glaucomatous symptoms result. Dr. Smith remarks that, if the circumlental space is obstructed, "the escape of fluid from the vitreous chamber is retarded, the vitreous chamber becomes over-filled, the lens and its suspensory ligament advance, pushing the ciliary processes against the periphery of the iris, the periphery of the iris applies

* Donders on Glaucoma, Report on the Heidelberg Ophthalmological Congress, *Ophthalmic Review*, vol. ii. p. 189.

itself to the posterior surface of the cornea, the angle of the anterior chamber (Fig. 3) is closed, and glaucoma is established. Then, as the pressure rises, a passive hyperæmia is set up, in a manner which is explained by Dr. A. Weber," who holds that the ciliary processes, becoming swollen from various causes, push the iris forwards, and so start the glaucomatous state. With reference to this theory, one is disposed to inquire why glaucoma is not more frequently found among aged people, supposing it depends upon senile increase in the size of the lens. Pathology.

Recent anatomical and pathological researches have done much to demonstrate the importance of the structures (lymphatic spaces) forming the angle of the iris (Fig. 3) through which serous fluid passes outwards from the interior of the eye. In not a few specimens taken from glaucomatous eyes Fontana's spaces and Schlemm's canal have been found occluded, and so it is assumed the escape of fluid through this channel might have been prevented. Supposing, however, that the anterior lymph path (Fig. 4) had been only partially closed, from the effects of previous inflammation extending from the iris or ciliary body, the escape of serum from such an eye would be retarded, increased tension of the globe would probably follow, and so augmented pressure and obstruction to the lymphatic and venous circulation from within the eye outwards. Under these conditions, in a case of passive glaucoma a slight excess of effusion might at any time give rise to paroxysms of glaucoma. With reference to these ideas, however, so high an authority as Dr. A. Alt remarks, that, after a large and careful investigation, it is impossible to say that we are as yet in possession of an anatomical explanation of the cause of the array of symptoms to which we apply the clinical name of glaucoma. Dr. Alt adds, that Knies thought to have found this cause in the obliteration of Fontana's spaces, but "he has gone beyond the mark, since, as many have already proven, this obliteration is often found without having caused glaucoma, and, on the other hand, is frequently wanting in glaucomatous eyes." I have little doubt that symptoms of glaucoma may sometimes be caused by a swollen lens pressing upon the angle of the iris, or by occlusion of the lymphatic spaces in this locality. The

more carefully we study the subject, however, the clearer it becomes, "that glaucoma is a symptom, or presents certain symptoms, which may be caused by various pathological changes in the eye." And to apply appropriate remedies, we must endeavour rightly to comprehend the nature of the causes in any case which have produced the symptoms of glaucoma.

*Symptoms.*

*Symptoms.*—Glaucoma is most commonly met with in old people, and is more frequent among women than men. In the

Advancing presbyopia.

first instance, the patient complains of advancing presbyopia; he finds that month after month he has to increase the distance between the eye and the book he may be reading, in order to see the letters distinctly. The reason of this is, that the power of accommodation is in a measure destroyed by changes going on in the choroid, which, though hardly sufficient to cause any greatly increased tension of the globe (p. 28), may nevertheless affect the nerves of the ciliary muscle, so that it can no longer act efficiently on the lens, and render its anterior surface sufficiently convex to bring divergent rays of light to a focus on the retina.

Impairment of the field of vision.

The patient also complains of defect of sight, which may be found to be partly due to contraction of the outer part of the field of vision. This is caused by the compression to which the peripheral parts of the retina are subject, as well as their distance from the blood supply, which is checked sooner at the periphery than at the central portion. By carefully examining the state of the patient's eye, we shall probably discover that, not only is his field of vision contracted, but very probably that certain portions of the retina are not sensitive to the stimulus of light.

Periodical pain.

On inquiry, we shall find that our patient has suffered from uneasiness, and often from a considerable amount of pain, of a periodic character, situated over the eyebrow and along the side of the nose. This pain, which is due to exacerbation of the choroidal congestion, and consequent augmentation of the tension of the eyeball, usually comes on towards evening, and lasts for a few hours, the patient's sight becoming misty during the paroxysm. The degree and character of this pain are uncertain; in some cases it is very intense, while in many instances it is trifling. Another symptom, noticed at an early period of the

complaint, is that the patient sees a halo surrounding the flame of a candle, or other luminous object in front of him. Halo.

In the early stages of glaucoma the tension of the eyeball is only slightly increased, and this is most apparent towards evening; subsequently, the increased tension becomes permanent, and varies according to the stage of the disease. We shall probably notice several enlarged veins coursing over the sclerotic. The aqueous alters in colour, rendering the fibres of the iris indistinct. The state of the pupil will be found to vary according to the progress which the affection has made; at an early stage it acts sluggishly on the stimulus of light, but as the disease advances it gradually becomes less active, until at length it remains widely dilated and insensible to light. Tension increased. Congestion. Pupil inactive.

On making an ophthalmoscopic examination, the vitreous will be discovered to be somewhat hazy, and the retina hyperæmic, with its veins tortuous and deeply congested. The arteries in the early stage of the disease are normal, and subsequently perhaps slightly contracted; in both sets of vessels a distinct pulsation will be noticed, or, if it does not already exist in the arteries, it may be induced by slight pressure with the finger on the eyeball. The optic disc is cupped. Retinal veins dilated. Pulsation.

In the majority of cases of glaucoma these symptoms continue for months, and often for years, the patient's sight in the meantime gradually failing. It is because glaucoma is generally unaccompanied by congestion of the ciliary zone of vessels or other very marked symptoms, that its nature is often overlooked until irreparable mischief has been done.

But in no inconsiderable number of cases of glaucoma, these symptoms having lasted for a longer or shorter period, become, perhaps, suddenly augmented, it may be in a single night; the tension of the eyeball increases, the pain is intense, and the ciliary zone and vessels of the conjunctiva are deeply injected. The patient's cornea becomes hazy, and its sensibility is diminished from compression of the ciliary nerves. The dimness of vision increases, the pupil is dilated and stationary; the lens is apparently of a green colour. This last appearance arises from the lens itself assuming a yellowish hue, while the aqueous becomes of a bluish tint, the combination causing the Progress: All symptoms intensified. Cornea insensible. Pupil dilated, greenish.

greenish-yellow colour, which at one time was supposed to be pathognomonic of glaucoma, and gave rise to its name.

If now the eye be examined with the ophthalmoscope, the cornea and lens remaining sufficiently transparent to allow of the rays of light reaching its fundus, the retinal veins will be seen to be tortuous and greatly congested; they are sometimes beaded, from the formation of varicosities. The calibre of the arteries, on the other hand, is contracted, and a pulsation may be noticed in both sets of vessels. The fundus of the eye is of a brick-dust colour, owing to the capillaries of the retina and choroid being uniformly congested; and spots of extravasated blood are not uncommonly noticed both in front and behind the lamina vitrea. As the disease advances the dioptric media become hazy, and it may be impossible to see the further changes that take place in the fundus of the eye. The nerve elements of the papilla becomes atrophied, and the disc is deeply cupped, the lamina cribrosa protruding backwards, so as to occupy a plane posterior to that of the sclerotic. A few days, or even hours, may complete the picture of glaucoma. But, as a general rule, a remission in the symptoms takes place, and a succession of such attacks follow at longer or shorter intervals, until the eye is destroyed. The disease having run its course, the pain usually abates, but the eye is lost as an organ of vision.

Venous congestion of fundus.

Further changes hidden.

Disc deeply cupped.

2. Glaucoma simplex. Very insidious.

2. *Glaucoma Simplex* is a very insidious disease. The external appearance of the eye is probably unaffected, as are also the iris and refractive media. The patient complains of little or no pain, and the only constant symptoms noticed are the steadily increasing presbyopia, which after a time convex glasses fail to relieve; moreover, there is contraction of the field of vision, together with augmented tension of the eyeball, which, though scarcely perceptible at the commencement of the attacks, becomes, after a time, a marked feature in the case.

The changes in the fundus of the eye progress at an equivalent rate, and frequently in both eyes at the same time; they are much the same as those above described, and the termination of the disease is similar—namely, stony hardness of the globe, dilated pupil, opaque lens, a hazy, anæsthetic condition of the cornea, and total loss of vision.

3. *Secondary Glaucoma*, as I have before remarked, may follow various diseases of the eye; as, for instance, cases of cyclitis, occlusion of the pupil, diffuse keratitis and anterior staphyloma of the sclerotic. It occasionally occurs after wounds of the lens, or from irritation induced by the presence of a dislocated lens in the vitreous chamber. Lastly, we sometimes meet with cases of glaucoma following hæmorrhage into the retina and choroid. The glaucomatous changes in the eye, under these circumstances, pursue precisely the same course as I have already described—the hardness of the globe of the eye and cupping of the optic disc being characteristic of the disease. But one, or frequently more, large patches of blood in the retina point plainly to the existence of diseased vessels, the glaucomatous symptoms being secondary to those of hæmorrhage. 3. Secondary glaucoma.

*Prognosis.*—The prognosis in cases of glaucoma cannot be doubtful. In time it is sure to lead to blindness of the affected eye, and in all probability the other eye will follow in the same course if the disease be allowed to run on. Provided, however, the glaucoma is in its premonitory stage, and the intervals between the attacks of pain and other symptoms are well marked, we may hope to stay the progress of the disease. *Prognosis.*

*Treatment.*—With regard to the treatment of glaucoma, there can be no doubt whatever that, unless in certain cases, to which I shall subsequently refer, iridectomy, if practised sufficiently early, may arrest the further progress of the disease. In making this assertion, it must be clearly understood that by iridectomy I do not mean simply excision of a portion of the iris, however large it may be;—the operation consists in the successful removal of a section of the iris, together with its ciliary attachments. *Treatment.* Iridectomy in early stages. The operation must be complete.

I have alway deprecated the hasty performance of so serious an operation as iridectomy, a proceeding which has without doubt been resorted to with too great freedom by some surgeons. Mr. Hancock, as far back as the year 1860, remarked that, "from the situation in which Von Graefe makes his incision I believe that he at the same time cuts through the ciliary muscle, whence the success of his operation; and I quite expect that in process of time it will be found, that the extent of this incision may be materially diminished, and the tearing away of the iris

altogether dispensed with." It is remarkable that, twenty years after this opinion, M. De Wecker writes that, "although it is very possible that I shall during the whole course of my professional life perform excision of the iris, as being the most certain operation against glaucoma, I am convinced that with the progress of knowledge some other proceeding, more simple and essentially more logical, will be substituted." It seems to me rather more to the point to endeavour to define the class of cases in which iridectomy should be performed, and then to determine the treatment best adapted for the relief of instances of glaucoma in which this operation is uncalled for.

I must reiterate my opinion that, in instances of acute serous choroiditis or "glaucoma fulminans" iridectomy should be performed without an hour's delay. From the instant we see the patient eserine should be freely applied to the eye, and an iridectomy done as soon as possible.

In cases of glaucoma, other than those of traumatic origin, or of the hæmorrhagic form, but in which the tension of the globe is much increased and the paroxysms of pain are severe, eserine should be freely employed, and then the sooner an iridectomy is performed the better.

On the other hand, if the symptoms of glaucoma, although marked, are not urgent, eserine (of the strength of grs. ij sulph. eserine, water ℥j) should be applied to the surface of the conjunctiva once a day, and if the circumorbital pain increases, two or three times during the twenty-four hours. This remark is especially applicable to the case of comparatively young women, who have undergone great mental anxiety or grief. I have now under my care several cases of this kind in which both eyes were, so far as I can judge, equally affected; in one eye I have performed iridectomy, and subsequently more than one sclerotomy, in the other simply used eserine. The eye not operated on, as far as my experience at present extends, has remained the better of the two.

Iridectomy should not be performed in this latter class of cases, because it frequently happens that in subacute glaucoma the patient's sight under the use of eserine will remain practically good for years; and the operation of iridectomy,

even if performed in the most perfect manner, is not without its attendant evils. In the first place, in spite of all we can do, a tag of the iris or ciliary body may become entangled in the wound, and set up sympathetic irritation in the other eye.

Beyond this, my experience teaches me that, after performing iridectomy for the relief of glaucoma in one eye, the other eye becomes more disposed than it otherwise might be to glaucoma. On this subject I cannot do better than refer to the recently expressed opinions of Drs. C. R. Agnew and D. Webster, of New York. These surgeons remark* :—

Effects on sound eye.

"An operation for the relief of acute glaucoma in one eye may quickly be followed by an attack of the same disease in the other. Von Graefe, who first performed the operation of iridectomy for the cure of glaucoma, also first observed and described the complication of which we speak. In his experience the fellow-eye was attacked within fourteen days after the operation on the first in about thirty per cent. of the cases in which the operation was done for primary inflammatory glaucoma ; it sometimes occurs after an operation for chronic glaucoma. In fact, it is not safe to operate upon one eye for glaucoma of any kind without previously warning the patient that the second eye may be attacked within a few days, or even a few hours, after the operation. The patient invariably attributes the attack in the second eye to the operation upon the first, and, if not informed beforehand of the possibility of its occurrence, will be very likely to blame the surgeon for withholding his knowledge of such liability.

"It is now very generally conceded that the attack of acute glaucoma excited in the fellow-eye, in such cases, is not a true sympathetic inflammation. It is believed rather that anxiety of mind, the excitement attendant upon an operation, the hyperæmia of the eyeball, caused by the administration of ether, and the shutting up of an eye with a bandage, are sufficient to awaken an acute attack in an eye already predisposed to glaucoma. And it is fair to infer that an eye which has shown no

* *Medical News*, p. 202, Feb. 25, 1882.

glaucomatous symptoms, subjective or objective, *is predisposed* to the disease if the fellow-eye is so affected." I have referred to a case and specimen illustrating this point when describing the operation of iridectomy (p. 280).

"In the majority of cases where the second eye is so attacked, it is necessary to operate upon it with as little delay as possible. In some cases, however, it will yield under the use of eserine. After the operations for glaucoma, it is well to leave the fellow-eye unbandaged."

The risk of iridectomy, therefore, being by no means inconsiderable, the question arises as to there being any less serious operative means by which we can relieve the symptoms of glaucoma. Supposing a patient suffering from subacute glaucoma under the influence of eserine continues to suffer from attacks of circumorbital pain, and above all, that his field of vision steadily diminishes, I certainly recommend in such a case that Hancock's operation should be performed.

Eserine having been freely applied to the conjunctiva for several days: "A Hancock's knife is introduced at the outer and lower margin of the cornea, where it joins the sclerotica. The point of the knife is pushed obliquely backwards and downwards, until the fibres of the sclerotica are divided obliquely for rather more than one-eighth of an inch; by this incision the ciliary muscle is divided, whilst if there be any fluid accumulated, it flows by the side of the knife."

The quantity of fluid which escapes from the eye at the time of the operation varies considerably; in some cases it is marked, in others scarcely appreciable. Mr. Hancock remarks that, in performing this operation, care should be taken not to allow the incision to extend at all into the transparent cornea, as when this takes place the iris is apt to protrude through the cut. In fact, the object of the operation is to incise the angle of the cornea through the sclerotic, extending the incision into the ciliary body. I am convinced this operation is not unfrequently attended with favourable results. It may, however, have to be repeated if the tension of the eyeball subsequently increase.

*Sclerotomy.*—This operation is strongly advocated by M. De Wecker, and as the proceeding he now adopts differs somewhat

from that which he formerly recommended, I will quote his own account of sclerotomy. M. De Wecker remarks : "I have had sclerotomes made, varying in breadth from two to four millimetres, with lance-shaped points. With this instrument at a distance of one millimetre from the margin of the cornea, I transfix the anterior chamber, but in such a way that the edge of the sclerotome shall form a tangent to the inferior or superior extremity of the vertical diameter of the cornea, and that it shall, as it passes through the anterior chamber, incise the angle of the iris in its whole extent."

Eserine having been previously freely applied to the conjunctiva, I have performed sclerotomy a considerable number of times, but according to my experience it is liable to the objection that the iris is likely, and to my certain knowledge has become, entangled in the wound, and caused an attack of sympathetic cyclitis in the other eye.

In cases of hæmorrhagic glaucoma, iridectomy must not be attempted ; the same remark applies to instances of complete glaucoma. The reason is that in hæmorrhagic glaucoma the sudden relief of tension would probably lead to extensive extravasation of blood into the globe of the eye. In cases of complete glaucoma, the risk of inducing sympathetic irritation in the other eye is so great after iridectomy as to lead us to advise the removal of the diseased globe if it causes the patient much pain, rather than run the risk attending an iridectomy.

Atropine counter-indicated in glaucoma.

Atropine should never be applied to the eyes of patients suffering from glaucoma or a suspicion of increased tension of the globe of the eye ; in not a few cases, the use of this drug in these circumstances has been followed by an attack of acute glaucoma. Patients having had a fair amount of vision have had a solution of atropine applied to the conjunctiva ; in the course of two or three hours violent pain and increased tension of the eyeball lens follows, lasting probably three or four days, and ending in complete loss of sight in the affected eye.

Eserine.

I have in one case seen an attack of acute glaucoma follow the application of eserine to the eye.

## CHAPTER XIII.

## DISEASES OF THE RETINA.

*Hyperæmia of the Retina—Retinitis—Retinitis Albuminurica—Retinitis Pigmentosa—Hæmorrhage into the Retina—Retinitis Apoplectica—Embolia of Central Artery of Retina—Detachment of the Retina—Glioma of the Retina—Hemeralopia—Snow-Blindness—Colour-Blindness—Hemiopia — Scotoma—Amblyopia—Amaurosis.*

### HYPERÆMIA AND INFLAMMATION.

Hyperæmia of Retina: transient.

HYPERÆMIA OF THE RETINA* may be a transient affection, depending on overwork of the eye, or upon a deranged state of the stomach. In these circumstances the congestion passes away so rapidly, that it is not likely to attract the attention of either the surgeon or patient. But whatever the exciting cause of the hyperæmia, should it remain in force, inducing chronic congestion of the vessels of the retina, serious results may follow.

Hyperæmia of retina.

We can hardly appreciate hyperæmia of the vessels of the retina unless by means of the direct method of ophthalmoscopic examination, and even then the condition of one eye should be carefully compared with that of the other eye, before we arrive at a conclusion on this point. In cases of unquestionable hyperæmia of the retina, its vessels are found to be more tortuous, thicker, and deeper in colour than they are in health.

Ophthalmoscopic appearances.

The optic papilla is a dusky red hue, and its outline is often slightly cloudy from the presence of serous effusion into the retina.

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* The appearances presented by the healthy retina are referred to at p. 42.

Hyperæmia of the retina not unfrequently depends upon venous congestion produced by some impediment to the return of blood from the eye, it may be from some increase in intra-ocular tension, from disease of the heart, or from the pressure exercised on the veins by a morbid growth in the orbit. In such cases a plexus of large veins and arteries may often be seen spreading over the whole extent of the retina, with scarcely a vacant interval. Venous congestion.

A patient suffering from hyperæmia of the retina complains of occasional flashes of light, and an inability to continue his accustomed work for any length of time, from a sense of fatigue and heat in his eyes. The most common cause of hyperæmia of the retina is from the efforts a patient makes to overcome some error in the refraction of his eye; of these errors hypermetropia and myopia are the most frequent. Then, again, workmen, such as compositors, engravers, bootbinders, and so on, who are engaged for many hours on work requiring active and concentrated effort of the eyes, are apt, especially if in bad health, to suffer from hyperæmia of the retina. Symptoms and causes of hyperæmia of the retina. Errors of refraction. Overwork.

In the natives of India the fundus of the normal eye is of a grey colour, in consequence of the presence of the black pigment in the hexagonal cells of the lamina vitrea, and the choroid being thus shut out from view, congestion of the retinal vessels is generally very evident. In many cases of malarial fever I have found the retina deeply engorged with blood, and this condition of hyperæmia continues after the paroxysms of fever have left the patient, and by interfering with the healthy nutrition of the retina sometimes leads to irreparable damage to the eye. Dr. C. S. Bull is doubtful if malarious influences are capable of effecting any abnormal changes in the human eye. My own experience, however, differs from that of Dr. Bull; and, as I remarked when referring to œdema of the papilla (p. 318), there appears to be an intimate connection between malaria and certain affections of the blood or blood-vessels of the eye. Malaria.

The treatment of hyperæmia of the retina must depend upon its cause, and I need not reiterate the remarks already made respecting the management of such cases if depending upon malaria. In instances of congestion of the retina depending *Treatment*

upon the eye being overstrained in cases of faulty refraction, proper glasses must be supplied to the patient. And in cases of hyperæmia from excessive work, often in a bad light, rest must be ordered and the hygienic circumstances of the patient attended to. It is absolutely necessary to prevent the continued existence of hyperæmia in so delicate a structure as the retina, otherwise serous effusion from the vessels occurs, in the course of time leading to fatty degeneration of the nerve elements, and to the formation of cavities in the connective tissues supporting the molecular substance of the retina. Cysts formed in this way have not unfrequently been found in retinas affected for a length of time by hyperæmia, their cavities being distended with serum, lymph cells, and fatty matter.

ANÆMIA OF THE RETINA.

ANÆMIA OR ISCHÆMIA of the retina is most marked in cases of obstruction to the circulation through the retinal vessels consequent on embolism of the central artery, and will be further considered in another section. In cases of chlorosis the tension of the eyeball is unaffected, and consequently the quantity of blood circulating in the retina remains much the same as in health, and so the appearance of the fundus of the eye is seldom altered from its normal condition even in advanced instances of anæmia.

From overdoses of quinine ischæmia of the papilla and retina occur accompanied at times with loss of sight lasting for a considerable period. The disc and retina, under these circumstances, present much the same appearance as in cases of embolism of the central artery of the retina.

## RETINITIS.

Retinitis not common.

In consequence of the intimate relations that exist between the choroid, optic papillæ and the retina, it follows that inflammation is seldom confined to any one of these structures. And in practice we find that neuro-retinitis or retino-choroiditis is more common than retinitis. Nevertheless, we meet with instances of retinitis, generally the result of syphilis, or some other constitutional affection. Persons having disease of the kidney, diabetes, leucæmia, and malaria are apt to suffer from retinitis.

RETINITIS ALBUMINURICA.—Interstitial retinitis occurs from time to time among patients suffering from Bright's disease of the kidneys, the neighbourhood of the macula lutea being chiefly implicated. Dr. Gowers* remarks that in these cases of kidney disease, the retina presents certain elements which are variously combined in different cases. These are:—1. Diffuse slight opacities and swelling of the retina, due to œdema of its substance. 2. White spots and patches of various size and distribution, due for the most part to degenerative processes. 3. Hæmorrhages. 4. Inflammation of the intra-ocular end of the optic nerve. 5. The subsidence of inflammatory changes may be attended with signs of atrophy of the retina and nerve.

NEPHRITIC RETINITIS.

Pathology.

These changes are due to œdema and increased growth of the elements of the connective-tissue fibres of the retina; these fibres become thicker, presenting an almost glistening whiteness when seen by the ophthalmoscope. Sections made through the diseased portions of the retina demonstrate the existence of peculiar club-like swellings of the nerve fibres; these thickened fibres refract light strongly. The diseased structures are infiltrated with granular matter, white blood corpuscles, and cells which appear round or semi-lunar, with one or more offsets and a shining round nucleus. There is not unfrequently a layer of granular cells beneath the membrana limitans, so that this membrane protrudes into the vitreous body. In both the inner and outer layers of the retina cavities form, containing peculiar branched cells. Detachment of the retina to a greater or less extent is by no means uncommon in cases of albuminuric retinitis. A considerable number of hæmorrhages are found in the retina caused by pathological changes noticed in the walls of the bloodvessels. The condition of the retinal arteries in the class of cases we are considering are similar to those noticed in the kidney and other parts of the body, consisting of a thickening of all their coats, especially of the sub-endothelial layer of the interna. The diameter of the vessel is increased, while its lumen is diminished. There seems evidence leading to the inference that the changes in

* "A Manual and Atlas of Medical Ophthalmoscopy," by W. R. Gowers, M.D. 2nd edit., p. 184.

the walls in the arteries precedes those in the stroma surrounding them.

The optic nerve undergoes somewhat similar changes to those observed in the retina, although the alterations in its arteries are not so well marked.

*Causes:* renal disease, malaria, and blood poisoning.

Pathological changes of this kind are, however, not confined to cases of Bright's disease; the dyscrasia induced by malaria may produce the same result. I have watched instances of retinitis albuminuria for some years past, and always considered them analogous to the degenerations of the muscular or secreting organs of the body which we sometimes notice in persons exposed to malarious influences, and which may run their course either with or without the presence of albumen in the urine; sugar, in fact, may take the place of albumen in the urine under these circumstances. We also meet with a similar morbid condition of the retina in alcoholic poisoning from changes in the blood and the walls of the capillaries, which render the former unfit to supply healthy nutrient material to the tissues, and the latter calculated to hinder osmosis, and to impair still further the nutrition of the parts around them, so that disease of the retina is the result.

Walls of vessels altered.

Cases of brain tumour and Bright's disease.

It is well to bear in mind the fact that disease of the brain may produce appearances in the retina similar to those of nephritic retinitis. For instance, a patient under my care, aged twenty-three, exhibited in both eyes the appearances which belong to the most complete picture of retinitis albuminurica, but she had no albumen or other evidence of kidney-trouble, and not until a short time before death had she any symptoms to cause suspicion of brain-disease. The autopsy disclosed a tumour in the region of the septum lucidum. In a second case, that of a girl aged fifteen, the opthalmoscopic appearances were identical, but the patient suffered from Bright's disease, which caused her death, and allowed of microscopic examination of the retina and optic nerves.

Retinal appearance identical.

The features common to both cases, in the ophthalmoscopic picture, were great swelling of both optic papilla, redness and infiltration, its outline being indistinct and vessels swollen—in the case of tumour there was ecchymosis over the right papilla; near both discs opaque white patches, with dotted edges such as

those seen in nephritic retinitis, were present: at the macula there were the usual radiating figures, and extravasations of blood in various places.

In the case of tumour, the ocular lesion was confined strictly to the eye—the optic nerve trunks, close up to the globes possessed a normal structure as seen by the microscope. The lesions in the retinæ in both cases were extremely alike, making any distinction between the two by the microscope almost as impossible as by the ophthalmoscope. There were in both cases sclerosis of the fibres of the optic-nerve layer—the ganglion cells atrophied or sclerosed—the granular layers studded with or almost transformed into fat molecules — hypertrophy of the connective tissue of the nerve and retina, and the choroidal tissues were somewhat sclerosed. The only difference in the two cases was that, in the patient with cerebral tumour, the swelling of the retina belonged more to hypertrophy of the inner retinal layers and papilla, while in the patient with Bright's disease the swelling affected principally the radiating fibres of the external granular layer. Structural changes similar.

The outcome of the matter is, that we cannot assert the infallibility of our diagnosis of Bright's disease with the ophthalmoscope. Many good observers have denied the possibility of mistake, but the retinal pictures may be completely simulated by neuro-retinitis from cerebral tumours, or from diabetes mellitus, malarial poisoning, and perhaps from alcohol. Difficulties of diagnosis.

We are therefore compelled to examine the urine as well as the eye, and to study the signs of cerebral disturbance, however obscure they may be in some cases. But it remains true that the retinal lesions above described belong in the large majority of instances to Bright's disease.

*Symptoms.*—The appearances presented by examination with the ophthalmoscope will vary in different cases of nephritic retinitis, according to the part of the retina involved and the stage of the disease. In most cases the first changes observed in the retina, are clusters of small white spots in the substance of the retina, it may be near or at a distance from the optic nerve. At first they are soft-edged and rounded, and as they get larger, they become irregular. As Dr. Gowers observes, these Ophthalmoscopic appearances.

White patches.

small white spots generally appear round the macula lutea, arranged in a radiating manner. The larger spots can be distinctly seen, but the smaller ones are only to be recognized by careful direct examination. These spots after a time run into one another and form glistening white patches. Striated hæmorrhages are almost always present—"mare's tail" extravasations of blood as they have been called; at other times they are linear, and not unfrequently the extravasations are more or less flask-shaped. When large they are irregular in shape, and occupy the deeper layers of the retina. These changes may advance so as to involve a large part of the retina without symptoms of neuritis, but in most cases the margins of the papilla are blurred and swollen.

Hæmorrhages.

In other cases of nephritic retinitis we find from the commencement of the affection that considerable swelling of the retina occurs, the papilla being completely obscured. The vessels, especially the arteries, are concealed in the swollen tissues. The veins are engorged and tortuous. Large blotches and also striated hæmorrhages are present. Numerous soft white patches are apparent. As the disease subsides evidence of atrophy in all the previously affected tissues are visible.

In the slighter forms of nephritic retinitis the patient's vision is hardly affected. In serious cases impairment of sight without marked limitation of the field of vision or colour-blindness exists. Sight is rarely altogether lost.

*Prognosis.*

The course of this disease will vary according to the condition of the kidneys, but it is quite possible that extensive detachment of the retina may occur at any period. With the exception of detachment of the retina it is not uncommon to see the other changes effected in the retina clear away for a time. The hæmorrhages and white spots may gradually fade away, generally to recur however before very long.

*Treatment.*

*Treatment.*—In cases of Bright's disease, it is hardly necessary to say that the retinal affection is as incurable as the principal malady, and no improvement can be looked for.

Must vary with the cause.

I have watched several cases of neuro-retinitis following malarious fevers, and have certainly seen them improve under a steady and well-regulated course of arsenic, strychnine, and iron.

But above all things change of air, and in fact absolute removal from malarious influences, is necessary for the cure of miasmatic diseases. When therefore a patient comes under our notice, suffering from symptoms such as I have above described, and which we can trace to malarious influences, we have it in our power to save him from irrecoverable blindness by ordering him off to sea; or to a good climate (see Case, p. 329). Removal from malarial influences.

In instances occurring from the effects of alcohol, we must endeavour to stop the use of all intoxicating fluids, and by wholesome food, tonics, and improved habits of life, endeavour to restore our patient's general health; for we know of no means more likely to improve the condition of his blood, and hence of the local disease. Improved habits of life.

RETINITIS PIGMENTOSA (Plate IV., Fig. 1).—I have already referred to the pathology of retinitis pigmentosa (p. 295) in connection with affections of the lamina vitrea. The epithelial layer of the lamina vitrea may produce a simple thickening of its pigmented cells, one layer being superimposed upon another layer. In cases of retinitis pigmentosa, however, the hyperplasia of these cells is peculiar, in that it sends offsets of pigmented epithelium into the retina. These processes cause a chronic interstitial inflammation of the retina, which leads to hypertrophy of the connective tissue, and destruction of the nerve element of the retina. Beyond this, a growth of new connective tissue takes place in that portion of the retina into which the epithelial processes extend, and into the peri-vascular sheath of the retinal bloodvessels, which thus become obliterated. This process commences at the peripheral part of the retina. During these changes the choroid generally remains unaffected. Dr. A. Alt remarks that during the progress of this disease the pigmented cells frequently enter into and extend along the peri-vascular sheath of the retinal bloodvessels; nevertheless the primary disease is not one of the vessels, as has been stated by some authors. RETINITIS PIGMENTOSA. Pathology.

Retinitis pigmentosa is said to be most commonly met with among the offspring of persons nearly related to one another;* but this can hardly be the cause of the disease among

* "Atlas d'Ophthalmoscopie," par le Dr. Liebreich, p. 16.

the natives of India, as they are scrupulous in observing the restrictions they place upon the intermarriage of relatives : and yet I have seen a considerable number of instances of this disease among native patients. In the majority of instances of retinitis pigmentosa which I have met with, there has been a history of impairment of vision, not sufficiently marked to attract much attention in early life ; nevertheless, if careful inquiries be made, a history of defective vision may usually be traced to childhood. I am rather inclined to consider the disease as the result of inherited syphilis, but I have not noticed the notched teeth of syphilis in this disease, and it does not seem to be influenced by mercury. It is common to find this affection among several members of the same family.

Vision impaired from childhood.

Doubtful syphilitic origin.

*Symptoms.*

*Symptoms.*—As I have before stated, although retinitis pigmentosa is a disease which commences in early life, it may long escape notice. It runs its course, in fact, without the slightest pain, and the external appearance of the affected eye is probably healthy. The symptom first complained of is a gradual loss of sight, most marked after sunset, or when the patient is subjected to a dim light. The central portion of the retina may continue unaffected after its outer parts have been destroyed ; direct vision, therefore, remains comparatively good, while objects immediately around the central portion of the visual field are hazy, or even imperceptible. For this reason a patient suffering from this malady may be able to read small type, but cannot walk about with safety in a crowded thoroughfare.

Not striking.

Loss of sight after sunset.

Periphery of retina first affected.

Contraction of visual field.

As the disease progresses the field of vision steadily contracts, and ultimately the patient's sight is almost lost. Notwithstanding this, until an advanced stage of retinitis pigmentosa the pupil, though contracted, responds to the stimulus of light.

Pupil active.

Opacity of the lens.

Opacity of the vitreous is rare in this disease, but the lens is more often affected.*

Ophthalmoscopic appearances.

Pigment spots on retina,

On examining the eye with the ophthalmoscope in the early stages of the disease, the optic disc and retinal vessels appear of normal size ; towards the ora serrata irregular patches of black colouring matter may be noticed. These patches grow

* *Ophthalmic Review*, vol. i. p. 49.

from the epithelium of the lamina vitrea and extend into the retina spreading along the walls of the vessels—that is, the external coat, particularly of the smaller vessels is lined with pigment. spreading from its vessels.

With the further progress of the disease, the black irregular pigment spots continue to increase in the retina, spreading gradually from the periphery to the axis of the eye; the retinal vessels become mere streaks, and ultimately, when the patient has nearly lost his sight, the eye presents the following appearances :—Optic disc of normal size, and of a pale rose colour, looking flat, and no choroidal margin to be seen; the retinal vessels have dwindled away to mere threads, extending probably only a short distance beyond the margin of the disc; the fundus of the eye has a mottled appearance, and a number of black, spider-shaped bodies are scattered over it; these are particularly distinct towards the ora serrata, Plate IV., Fig. 3. Extension of pigment spots. Atrophy of retinal vessels.

*Prognosis.*—I do not remember to have met with a case, in which a person, under forty years of age, has been rendered completely blind from the effects of this form of disease. It usually takes years to advance from the stage characterized by the symptoms of hemeralopia to that of general impairment of vision; but its progress, though slow, is sure. I have tried every means in my power to stop it, but have never succeeded in doing so, the increase of the pigment in the retina continuing in spite of our best efforts. We must, therefore, give an unfavourable prognosis to patients suffering from retinitis pigmentosa; but we may console them with the fact that its development will be slow, and may possibly be arrested for several years at any stage; but beyond this, no reasonable hope can be entertained of improvement, much less of recovery. *Prognosis.* Total blindness rare. No known remedy. Prognosis bad.

HÆMORRHAGE INTO THE RETINA.—Effusions of blood into the retina are of frequent occurrence, and have been observed after injuries, through concussion, or direct wounds; or in the course of those changes which tend to impede the passage of blood through the optic disc (as glaucoma, inflammation of the papilla, and the adjoining retina), or through the orbit, especially when the cause is situated close behind the eyeball, or at the fissura orbitalis superior. A condition favouring hæmor- RETINAL HÆMORRHAGE. From injuries. From mechanical obstructions.

rhage, and connected with diminished power of the vascular walls, is that of hypertrophy of the left ventricle, or insufficiency of the aortic valves. It is frequently met with in Bright's disease, diabetes, anæmia during pregnancy, and in women weakened by lactation. Sudden closure of the jugular veins on both sides has occasioned hæmorrhage into the retina, or effusion of blood may occur in the course of changes within the eye (as tumours, retinitis), which give rise to hyperæmia of the retina and choroid, with atrophy. Hæmorrhages into the retina vary much in size, number, and position. They may be very small, or three or four times the diameter of the optic disc. There may be one or numerous extravasations covering the fundus. Their shape and aspect depends much on their position in the substance of the retina.

It is hardly possible to mistake extravasated blood in the retina for any other condition of the parts. If examined soon after the hæmorrhage has occurred, its colour is quite characteristic; subsequently this alters, and the hæmorrhagic effusions become darker, and are broken up into small patches. The larger extravasations may gradually soften down, and are converted into a yellowish fatty substance, which may ultimately become absorbed; but in many instances the hæmorrhage destroys the elements of the retina into which it has occurred. A circumscribed retinitis follows, leading to a cicatrix and blind spot: if the clot formed is large, to detachment of the retina.

Appearance of clots.

Later changes.

We frequently meet with cases of hæmorrhage in the retina unconnected with neuritis or any objective symptoms. These extravasations may be divided into three principal groups. First, effusions of blood, in which the hæmorrhage assumes a flammiform appearance, coursing along the fibrous layers of the retina. These hæmorrhages generally disappear rapidly; they are similar to those seen in cases of scurvy and petechial typhus.

Forms of hæmorrhage.

Secondly, hæmorrhages take place from the retinal vessels, and passing backwards, the blood causes a certain extent of detachment of the nerve layer from the choroid. A clot formed in this situation is apt to coagulate, its colouring matter sinks down to the most dependent part, the serum remaining fluid above, and the extravasation presents various shades of colour. Hæmorrhages of this kind seldom disappear without

Hæmorrhage deep into retina.

Effects of.

leaving some trace of their existence, either in the shape of a detached or otherwise damaged retina, and if these changes have occurred in the axis of vision, the patient's sight may be permanently impaired.

Hæmorrhage in old people.

A third variety of hæmorrhage is that met with usually among patients advanced in life: the extravasation occurs from a vessel of the papilla. I have a case of the kind now under my care; this old lady is in good health, and the only point in her history at all bearing on her present condition is that formerly she suffered rather frequently from epistaxis. Some ten days before I saw her she discovered that she had lost the sight of her left eye. We found that, extending from the edge of the papilla as far as the macula lutea, there was a clot of blood. Neither the arteries nor veins were perceptibly altered in size. There were no other hæmorrhages. In the course of time the hæmorrhage extended, the vitreous had become full of opaque flakes, and the patient's sight was destroyed. In cases of this kind, the extravasated blood may become absorbed, but it too often happens that repeated hæmorrhages occur, and the eye is lost.

Retinal hæmorrhage in young men.

There are another class of cases, instances of which I have had under my care, and they have been well described by Mr. H. Eales, of Birmingham, as "Primary Retinal Hæmorrhage in Young Men." He remarks that the hæmorrhages are usually multiple, often cause complete opacity of the vitreous, and when quite recent are of a venous colour.

Though occurring at all parts of the fundus, they are most common at the extreme periphery of the retina. They are not associated with any evidences of retinal disease, and are roundish, diffused, and not flame-shaped. They constantly recur, they are generally found in close proximity to the branches of the retinal vein, which are often lost in them, or a venous trunk is directly continuous with an opacity in the vitreous caused by the hæmorrhages, the calibre of the retinal vessels are unusually large in both eyes, the veins especially being dark, large, and tortuous. Vision often appears to be impaired only in proportion to the opacity of the vitreous. In some cases, the recovery is so complete that between the attacks no trace of the previous disease is found.

Hæmorrhages in young persons.

The patients are young males, the youngest of Dr. Eales' patients being aged fourteen, and the eldest aged twenty. All were previously, and while under treatment, troubled constantly with constipation, and occasionally with epistaxis, especially during the summer months. Two were very subject to headaches, three were habitually lethargic and indolent, and complained of depressing feelings and want of energy.

In one case, there was evidence of mitral incompetence. In the others, the heart presented no anomaly. The pulse in each case was below 60 at the time they first came under observation. The aortic second sound was accentuated in only one case. Pulse-tracings in three cases showed low tension, but they were taken some months after the hæmorrhages occurred; the condition of pulse-tension at the time of the hæmorrhage is therefore still undetermined.

In two cases only, there was the faintest shadow of albumen in the urine, and in no case were any casts found.

There was no indication of anæmia in any case; the blood of one case examined by the hæmo-cytometer was quite normal.

Among patients of this description who have come under my observation, in more than one instance, masturbation, or excessive sexual intercourse seem to have led to exhaustion, or, at any rate to a tendency to hæmorrhage. If these practices are avoided by the patients we may fairly hope the constipation, irritable heart, and other symptoms referable to lowered nerve action from which they suffer will pass away, and that no recurrence of the hæmorrhage will happen, otherwise the prognosis must be unfavourable. In most cases of hæmorrhage into the retina, such as those above referred to, sulphate of eserine in solution should be freely applied to the conjunctiva.

It is necessary always to be careful, in cases of sudden loss of sight in the central field of vision, to look to the condition of the macula lutea. I have seen more than once extravasation of blood limited to this spot.

Retinitis apoplectic.

In other cases, described as *Retinitis Apoplectica*, we find that, together with œdema of the optic papilla and retina, numerous ill-defined spots of hæmorrhage are observed. The veins of the retina are dilated, the arteries often of their normal size,

but the extravasations of blood are very characteristic. At times the effused blood forces its way into the vitreous chamber, but more often towards the choroid. The clots of blood retain their colour for a considerable time, and may then gradually become absorbed, but bear a marked tendency to recur. The loss of sight depending on extravasation of blood of this kind, depend much on the locality in which they have formed, but the prognosis in these cases is always serious. This affection generally occurs together with disturbance of the general circulation, due to affections of the heart, liver, or uterus, including pregnancy. Atheromatous degeneration of the coats of the retinal bloodvessels is, however, the most frequent cause of hæmorrhages of this description.

Retinal Affections in Heart Disease.

AFFECTIONS OF RETINA IN DISEASE OF THE HEART.—Impairment of sight, depending on disease of the heart, is not of frequent occurrence; when it does take place it is attended by the following conditions :—

1. *Capillary Congestions of the Retina and Venous Varicosities.*—Sometimes there are venous stases in the retina, but their progress is slow and gradual, so that vision is in no way troubled. It is only in exceptional cases that the venous congestion occasions disorders of vision either constant or periodical; but then we have no longer simple varices in the principal branches, but capillary congestions of the retina more or less marked.

The venous stases of the retina are to be sought for especially in the capillary branches. An ophthalmoscopic examination with inverted images is not sufficient to make out this capillary stasis; we must have an erect image and a strong magnifying power.

Extravasation.

2. *Extravasation of Blood into the Retina and Optic Nerves.*—In heart disease effusions into the retina take place both from the over-powerful impulse of a hypertrophied heart, or what is more common, from the insufficient impulse of the same organ when enfeebled. The rupture of the capillaries is sometimes prepared for by an alteration in the coats of the vessels. Generally only one or two branches are ruptured, and a single eye affected. In effusions of blood into both eyeballs we ought to suspect the presence of albuminuria or diabetes, &c.

EMBOLISM OF CENTRAL ARTERY.

*Symptoms.*

EMBOLISM OF THE CENTRAL ARTERY OF THE RETINA.—Embolism of the central artery of the retina is recognized by well-defined symptoms. The patient complains of sudden loss of sight in the affected eye. On ophthalmoscopic examination, we find that the optic disc is white, and its vessels greatly attenuated. The retinal arteries are recognized as narrow threads, often appearing as white bands. The retinal veins are small, in some part of their course they are usually empty, with here and there plugs of coagulated blood, extending for a short distance within them. The region of the macula lutea is covered with a greyish film, gradually shading off into the normal retina. This film is due to serous exudation into the retina, and generally covers the optic disc as well as the region of the macula lutea, and often the whole of the retina. As the effusion clears away, the appearance of the branches of the retinal artery remind one of the twigs of a branch of a tree covered with hoar frost, and are characteristic of this affection. After a time further changes occur in the eye, the vitreous becomes hazy, and the retina and optic papilla gradually pass into a condition of atrophy.

Ophthalmoscopic appearances.

In retinal vessels.

In some rare cases an embolus forms in one of the branches of the retinal artery, and œdema of the nerve structure around it occurs, causing limited impairment of vision, which is confined to that part of the retina supplied by the occluded vessel. The remainder of the field of vision may be perfectly normal.

*Prognosis.*

In cases of embolism of the central artery of the retina, the prognosis is unfavourable so far as the diseased eye is concerned. But embolism of the central artery of one eye does not in any way prejudice the other eye, which may remain perfectly healthy. So that although the loss of sight in one eye is complete, vision in the other eye may continue unaffected for the remainder of the patient's life.

DETACHMENT OF RETINA.

DETACHMENT OF THE RETINA (Plate IV., Fig. 2) from the choroid may arise, either from the effects of a blow on the eye, or from disease.

*Case.* Partial; following a blow.

*Detachment from a Blow.*—As an instance in point I may refer to the following case:—The patient had been struck with a racket-ball on the left eye; immediately after receiving the blow, he found he had completely lost the sight of th eye

When I first saw this gentleman I observed that the pupil was widely dilated; he could only distinguish large objects in certain directions, the injury evidently being in the axis of vision. On examining the eye with the ophthalmoscope, a considerable portion of the retina, extending from the optic disc outwards and downwards, was found to be detached, and below this a clot of blood could be seen, over which the retina appeared to hang. The fundus of the eye was intensely congested, as well as the optic disc, and there were several spots of extravasated blood scattered over the retina.

Appearance of retina.

Extravasation.

I recommended the patient to keep the injured eye closed, and to rest the other one as much as possible. In a month's time I again saw him; his sight had improved, and the congestion and extravasation of blood had almost disappeared: a considerable portion of the large clot noticed in the lower part of the eye had also become absorbed, but the appearance of the detached retina in the axis of vision remained unchanged.

Improved by time and rest.

It occasionally happens that the whole of the retina is dragged away from the choroid, and assumes a funnel-shaped form, the apex being at its point of attachment to the optic disc. The vitreous, however, must have passed into a fluid condition, to allow of the retina falling forwards in this way.

Complete detachment.

Complete or partial detachment of the retina can hardly be mistaken for any other condition. The detached retina presents a bluish-grey, floating, wave-like opacity, which is thrown into folds with every movement of the eye; the retinal vessels may be traced up to the margin of the detached portion, where they will be seen to terminate abruptly, or bend back, as in the above instance, at the point at which the retina deviates from the plane of the fundus of the eye. It is seldom necessary, however, to resort to minute distinctions of this kind, in order to determine the nature of the case. The jagged wound in the retina leaves the choroid exposed, and frequently the white glistening sclerotic may be seen through the rent.

Appearance of retina.

State of vessels.

*Detachment of the Retina from Effusion.*—Separation of the retina from the choroid, the result of a collection of fluid behind the former structure, is not necessarily accompanied by pain in the eye; but this symptom will of course vary with the nature of the cause which has given rise to the effusion. The patient

Separation of retina from effusion.

probably complains only of gradually increasing imperfection of sight; and as only a portion of the retina is usually detached, the field of vision is more interrupted than absolutely destroyed; so that in looking at an object immediately in front of him the patient will lose perhaps half the figure, the rays which fall on the detached portion of the retina not being recognized, and for the same reason, objects appear to be bent, or their outlines distorted in various ways. In other cases the patient first notices that the field of vision is cloudy, the cloud having a wavy motion, due to changes of position of the retinal elements which receive and localize the impression of light. Vision is not only distorted, but objects under examination are fringed with a coloured ring or halo; this condition is characteristic of effusion and detachment of the retina.

Field of vision interrupted.

Worse if near the macula lutea.

If the retina is detached at or near the macula lutea, the impairment of vision will of course be far greater than if a more extensive detachment exists at its periphery: but even then, in certain directions, the visual field may still remain tolerably perfect.* Under any circumstances the patient complains of coloured or white balls, fiery wheels, flashes of light, and such like phenomena due to excitability of the visual organ.

Detached portion seen to bulge forwards.

Ophthalmoscopic appearances.

If, under these circumstances, a portion of the retina only has been torn away from the choroid, the detached piece will be seen (with the ophthalmoscope by means of the direct method of examination) bulging forward into the vitreous chamber, like a small bladder; its surface is usually relaxed and folded, trembling with every movement of the eye. The refraction from this portion of the retina is hypermetropic. The colour of the detached tissue varies: in the early stages of the disease it remains transparent, looking like a grey film upon the background formed by the choroid. By degrees, however, the nervous tissue degenerates and becomes opaque. The opacity generally extends rather beyond the border of the actual line of detachment of the retina, and this border is deepened if the detachment be prominent, as a shadow is then thrown over the surrounding part of the retina.

Looks grey and opaque.

* M. Wecker, "Maladies des Yeux," vol. ii. p. 364.

We must follow up the retinal vessels from the optic disc to the point of apparent separation of the retina, and we shall notice that the vessels passing over the bladder-like projection are on a plane anterior to that of the fundus of the eye; and accordingly we shall have to alter our focal distance to see them distinctly. As they dip down on the other side of the projection they will again be indistinctly seen, till we readjust the focus. The calibre of the vessels as they pass over the retina is seldom altered, the vascular system being unimpaired; but the vessels passing over the effusion have an undulating movement imparted to them on every slight movement of the eye: an appearance which, together with the bulging forward of the retina, cannot be mistaken if the detachment is considerable, but requires practice and dexterity to recognize it if the detachment be only slight. The separation of the retina from the choroid may take place, apparently without any appreciable structural changes in the other tissues of the eye; or, it may be complicated with inflammatory or other abnormal appearances (Plate IV., Fig. 11).

Displacement of the vessels.

Circulation maintained.

Wavy motion of vessels.

Detachment of the retina such as I have described is generally noticed at its lower portion: this fact is explained by supposing that the fluid behind it gravitates downwards, and accumulating in the inferior part of the retina, produces these appearances. Occasionally this fluid contains blood, or pus, which will of course alter the apparent colour of the detached part. Particles of lime and small plates of bone have been found lining the inner surface of a detached portion of the retina. In detachment of the retina from serous effusion beneath it, there is not necessarily any increased tension of the eyeball.

Separation usually below.

Effusion of blood or pus.

*Prognosis.*—The prognosis of these cases of detachment of the retina is unfavourable; some few cases remain stationary, others have been said to recover; but, so far as my experience goes, the effusion behind the retina increases sooner or later, and leads to loss of sight in the affected eye.

*Prognosis* unfavourable.

*Treatment.*—Loss of sight must be the result of an accumulating effusion behind the retina, and its separation from the choroid, unless the surgeon can afford some relief to his patient. This may be done, as has been proved by Von Graefe, and

*Treatment.*

Puncture the sac from sclerotic.

Mr. Bowman.* Their mode of treatment is to pass two needles from without through the sclerotic into the effusion, so as to let the fluid escape into the vitreous, or externally into the choroid. Successful cases of the kind are authenticated.

First determine state of retina.

Before adopting this measure, however, in any particular case, it is necessary to determine whether the retina is comparatively healthy, so as to lead us to hope, in case the effused fluid is got rid of, and the retina restored to its normal position, that our patient will gain some advantage from the operation. We may judge of this pretty accurately by the appearance of the retina; if it looks dull and opaque, it is more than probable that its nervous elements have degenerated, and in that case it will be of little use interfering.

Operation.

Our intention in operating should be to make a free opening through the effusion, so as to allow it to escape into the vitreous chamber; the retina will then fall back into its normal position, and, unless structurally altered, its functions may be restored and the patient regain almost perfect vision. The plan Mr. Bowman recommends appears to be the best adapted for this purpose:—

Directions.

The site of the separation of the retina having been carefully studied with the ophthalmoscope, the patient is placed on a couch; and a stop speculum having been introduced to keep the lids apart, the surgeon passes a needle through the sclerotic vertically into the eye, transfixing the retina at its point of

Retina torn by two needles.

separation from the choroid; another needle is then inserted through the same opening, and the handles of the two being separated the one from the other, their points are made to diverge like the blades of a pair of scissors. In this way the retina is torn through, and the fluid behind it escapes into the vitreous chamber; usually a small quantity passes out along the needles, and exudes beneath the conjunctiva; but this is not always the case. After the operation the retina falls back into apposition with the elastic lamina.

Avoid wounding lens.

In these cases, the chief point to attend to is to avoid wounding

* *Ophthalmic Hospital Reports*, vol. iv. p. 135.

† Mr. Haynes Walton on Detachment of the Retina: *Med. Times and Gaz.*, 1866, vol. ii. p. 311.

the lens; but an ordinary amount of anatomical knowledge and skill will prevent this accident, and if we do not touch the lens, we may be sure that no injury will result from passing the needle into the vitreous, even if we do not succeed in effecting a cure. After the operation, the only necessary treatment will be to keep the eye closed for a few days with a pad and bandage. As I before stated, I have operated in this manner a considerable number of times, the proceeding being followed by temporary relief, but never by anything more favourable.

Detachment from staphyloma.

*Detachment of the Retina from Staphyloma and Fluid Vitreous.*—Besides detachment of the retina brought about by blows on the eye, and serous effusion between it and the choroid, other causes may produce a similar result. I mentioned one of these when discussing the subject of sclero-choroiditis anterior, observing that, as the sclerotic gradually yielded to the intra-ocular pressure, the choroid, being drawn into the staphyloma, may drag the retina after it, thus detaching it from its normal position. A similar result occurs at times in posterior staphyloma; but in this last affection, in addition to the mechanical effects produced by the protrusion backwards of the sclerotic, there is a tendency to general congestion of the choroid, and a fluid state of the vitreous, which may itself lead to detachment of the retina.

From fluidity of vitreous.

A like alteration in the consistency of the vitreous has been known occasionally to follow severe contusions of the eye, and such an accident may, therefore, give rise to detachment of the retina. Under these circumstances the alterations in the consistency of the vitreous appear to progress with remarkable slowness, so that the fact of the injury may be almost forgotten but symptoms of gradual impairment of sight, and floating bodies in the field of vision, attract the patient's notice, and we find on examining the eye that a fluid state of the vitreous exists, with detachment of the retina.

Tumours of Retina: Sarcoma.

TUMOURS OF THE RETINA: MEDULLARY SARCOMA (GLIOMA).—This form of sarcoma is most frequently met with among infants and young people. It originates in the connective tissue of the retina. These tumours consist of round cells,

about the size of pus globules, embedded in a small quantity of granular intercellular substance. The tumour is usually very vascular. As the morbid growth increases in size the retina is detached, and the tumour advances into the vitreous chamber. During its growth hæmorrhages frequently take place, and we find patches of blood in the tumour. It is not uncommon to see softened areas in the morbid growth. These sarcomas spread continuously, so that the whole of the retina and the optic disc, in the course of a short time, are occupied by the new growth; the intra-ocular pressure is increased, abscess of the cornea follows, and the sarcoma protrudes outwards.

*Case.* The following case illustrates the course of this disease, but, as I have before remarked, it most commonly occurs during infancy:

Early appearances. A., aged six years, was brought to me at the Ophthalmic Hospital, and presented the following conditions:—General health good: the pupil of the right eye was widely dilated, and a yellow reflection from the fundus could be seen, evidently proceeding from a morbid growth which projected into the vitreous chamber.

I advised the removal of the eye, but as the parents would not consent, the child was removed from the hospital. Twelve

Advanced growth. months afterwards they again brought him, and the right eye then presented the appearance delineated in Fig. 51. The child's health had fallen off, but the glands of his neck were not enlarged. The eyelids were greatly distended, and a fungating tumour was seen growing from the eyeball and protruding between the eyelids. Its surface was ulcerated, and bled when touched, but was usually covered with a crust of dried blood and matter.

Removal. I at once removed the morbid growth. On passing my finger behind the tumour, I felt that the optic nerve was much enlarged. I divided the nerve, therefore, as near the optic foramen as possible, and then applied the solid chloride of zinc to the bottom and sides of the wound. The child made a rapid recovery, and appears to have remained perfectly free from the disease.

Examination of the tumour. On examining the tumour, I found that the optic nerve was embedded in a morbid product, having all the characters above noticed as characteristic of glioma.

We not unfrequently have the opportunity of watching the growth of a tumour of this kind; and may then see through the

FIG. 51.

dilated pupil a glistening yellowish-white reflection from the back of the eye. The ophthalmoscope enables us to complete the diagnosis, and, if employed sufficiently early, demonstrates the fact of the morbid growth being limited to one part of the retina, giving it a thickened and mottled appearance. Subsequently, as the disease involves the whole of the retina, the eye assumes the appearance formerly known as the "amaurotic cat's-eye." The morbid growth advances towards the lens, the globe of the eye enlarges, and ultimately the tumour bursts through the cornea, and assumes the fungoid appearance depicted in Fig. 51. There can be no question as to the necessity of excising the eyeball, and with it the morbid growth, in cases of this form of disease. The operation should be performed so soon as the presence of the sarcoma has been diagnosed; any delay may be attended with the most serious consequences.

## FUNCTIONAL DISORDERS OF THE RETINA.

Hemeralopia.

NIGHT BLINDNESS, OR HEMERALOPIA.—The following extract, taken from a work stamped with the authority of Government,* gives a good, though marvellous, account of hemeralopia. Capt. Smith, R.N., reports that in September, 1801, the *Merlin* captured a Spanish privateer, and having been sent with twenty men to cruise in her as tender, he thus describes their adventure :—

Captain Smith's narrative of night blindness.

"In a few days, at least half the crew were affected with nyctalopia. We were chased one calm morning by a large xebec, carrying from eighty to one hundred men, and towards evening she was fast pulling up to us, our people having been fagging at their oars many hours without any relief. Knowing that night would deprive half of our crew of sight, it was proposed to try our strength with the enemy while it was daylight; this was answered by three cheers. The oars were run across, and the enemy by this time being within gunshot, the action commenced. After a time, to our great relief, he sheered off and pulled away from us ; we, in our turn, became the pursuers ; but when night came on, we took special care to lay our head from the xebec, and saw no more of her.

His method of treatment.

"This circumstance put me on devising some means of curing the people affected with night blindness, and I could think of none better than excluding the rays of the sun from one eye during the day, by placing a handkerchief over it ; and I was pleased to find, on the succeeding night, that it completely answered the desired purpose, and that the patients could see perfectly well with the eye which had been covered during the day ; so that, in future, each person so affected had one eye for day, and the other for night. It was amusing enough to see Jack guarding, with tender care, his night eye from even the slightest communication with the sun's rays, and occasionally changing the bandage, that each eye in turn might take a spell of night duty, it being found that guarding the eye for one day

By covering one eye by day.

* "Royal Naval Biography," 1835, vol. iv. part ii.

was sufficient to restore the tone of the optic nerve, a torpor of which and of the retina is supposed to be the proximate cause of the disease. I much question whether any purely medical treatment would have had so complete and, above all, so immediate an effect. Referred to retinal exhaustion,

"Persons affected with nyctalopia become perfectly blind as night approaches, and continue so till the approach of daylight; the medical treatment is bleeding and purging, blisters applied repeatedly to the temples, close to the external canthus of the eye, cinchona bark, joined with chalybeates, &c., all of which was impracticable by us, having no medicine on board our little vessel. I am aware that this disease frequently attends scurvy in tropical climates, and is sometimes occasioned by derangement of the digestive organs and hepatic system, in which cases our simple treatment would be useless; but in the above instance it was evidently caused only by the sun." and scurvy.

Although bordering on the marvellous, this account is, I think, worth recording, more particularly as I quite agree with Captain Smith as to the cause of hemeralopia; I believe it does occur from scurvy and over-stimulation of the retina.

We must exclude from this group cases of pigmentary degeneration of the retina, and in fact all diseases of the eye accompanied with structural lesions, which in themselves account for the night blindness; as, for instance, opacities of the vitreous, lens and cornea, myosis, and such-like affections, and simply confine our remarks to cases in which marked diminution in the acuteness of vision exists when the patient is removed from a bright light, and yet in which we can discover no lesions of the retina or of the dioptric media to account for the phenomena. Instances of the kind are common in the tropics. No lesion apparent in hemeralopia.

In hemeralopia the patient is not only blind at night, but at all times if taken into a room dimly lighted; he can see comparatively well in bright moonlight, or in a well-lit room. Hemeralopia evidently, therefore, arises from a state of torpor or exhaustion of the retina, which, under these circumstances, requires a greater number of luminous rays to produce a sensible impression than in the healthy eye. Patient cannot see in a dim light. The retina torpid.

*Causes.*—This condition of the retina may be brought about

by general anæmia and imperfect nutrition, or by intense excitation of the nervous structures, and consequent exhaustion; probably a combination of these causes is the most prolific source of hemeralopia. A patient, whether from bad food, impure air, or disease, falls into a state of anæmia, and if he be then exposed to the intense glare of a tropical sun hemeralopia is the result. It is unnecessary for me to cite instances to prove that such influences are a cause of night blindness, it being well known that sailors returning from a long voyage in the tropics, and predisposed to scurvy from ship-diet, are not unfrequently affected with hemeralopia; but direct exposure to the glare of the sun has hardly been recognized as a sole cause of night blindness.

From bad food and sun-glare,

or exposure to the sun alone.

*Treatment.* *The Treatment* of night blindness resolves itself, therefore, into endeavours to restore the nutritive functions by suitable diet, and such means as iron and strychnine, and, when required, by antiscorbutic remedies, giving the eye rest at the same time. If these objects are kept in view, I have never seen a case of hemeralopia that has failed to recover; provided, of course, that the patient has not been suffering from some incurable disease of the liver, kidneys, or other important organs of the body. In making this assertion, I restrict myself, in fact, to cases of hemeralopia in the limited sense above indicated, and not to cases in which the night blindness depends upon other and assignable causes.

Tonics, food, and rest.

SNOW-BLINDNESS. SNOW-BLINDNESS would appear to arise from somewhat the same causes as hemeralopia, the glare from the snow causing over-excitation, and, ultimately, loss of sentient power in the retina. The affection, however, usually passes away after the removal of its cause.*

Retinal exhaustion.

Mr. H. Cayley, Surgeon to the Calcutta Ophthalmic Hospital, gives the following account of snow-blindness. He writes :—

Dr. Cayley's narrative.

"As I was crossing the 'Zoji La' pass from Cashmir to Ladak

* Kane's "Arctic Expedition:" Dr. Hayes' Report of a Sledge Journey, Appendix, p. 489.

early in May, I had the opportunity of seeing many cases of snow-blindness, and a brief description of the affection may be of interest.

"The day of crossing the pass, my party were on the move for more than sixteen hours over fresh fallen snow the whole way, and soon after mid-day I noticed some of the servants and baggage coolies stumbling along with their eyes covered and protected as much as possible, and all complaining of intense burning and throbbing in the eyeballs, headache, and dimness of sight. I recommended what I had heard from natives of the mountains, and had myself found to give great relief—viz., the application of a handful of snow on the eyes for a few minutes, till the burning was removed, and repeating this at intervals. After the march was over, and during the night, all those whose eyes were affected, consisting of nearly half the party, suffered most acutely from deep-seated pain in the eyes and orbits, with more or less complete loss of sight; and many of the coolies, who were all hill-men, and accustomed to the snow, were sitting out in the cold night air, groaning with pain, but finding their sufferings less than in the smoky huts. The next morning two of the servants, and about twenty-five coolies, were suffering in a greater or less degree from the following symptoms: almost complete loss of sight; they could just see their way about, but some even were quite blind. The most intense intolerance of light; severe deep-seated pain and burning in the eyeballs and orbits, and generally bad headache. The other symptoms were profuse lachrymation, injection of the conjunctiva, and swelling and puffiness of the lids, and contracted and inactive pupils. Acute ophthalmia, in fact, with the symptom of nervous irritation especially prominent. In some only one eye was affected, but generally both, though not always in the same degree. In some the affection commenced after the day's march and exposure were over, but I think only in those who went into the huts, and were exposed to the irritating smoke of fires of wood and animal dung. The treatment I employed and which gave great relief, was warm fomentations, and a lotion of equal parts of tincture of opium and water dropped into the eyes, and keeping the eyes covered with a wet bandage.

*Symptoms.*

severe pain.

Sight almost lost.

Intolerance of light.

Ophthalmia.

*Treatment.*

The drops caused smarting for a few minutes, followed by great relief."*

Effects of Lightning. Illustration.

LIGHTNING-BLINDNESS.—Momentary exposure to a very bright light may induce impairment of vision, by destroying the sensibility of the retina. The captain of one of our coasting steamers consulted me a short time since on account of impaired sight, particularly marked at night. His vision had been perfect until within a few months of the time I first saw him; he was then at sea, and one fearfully dark and stormy night suddenly a vivid flash of lightning burst over the vessel: my patient states that for a few minutes afterwards he was perfectly blind, and although he recovered his sight to a great extent, it has since remained impaired. No abnormal appearance could be detected with the ophthalmoscope.

Similar effects from overwork.

The functions of the retina may become similarly injured from prolonged work on minute objects in a bright light, as in the instances of watchmakers and engravers, and yet the fundus of the eye may appear perfectly healthy.

Colour Blindness.

COLOUR-BLINDNESS (Tests for, see p. 28) in some instances comes under the class of diseases depending upon impairment of the functions of the retina, without any perceptible lesion in the nervous apparatus of the eye; on the other hand, colour-blindness is met with in a considerable number of diseases affecting, either primarily or secondarily, the brain and spinal cord. Excluding instances of this description, one meets with cases from time to time in which colour-blindness appears to be a congenital and hereditary affection; the patient's sight may in other respects be perfect, but he is unable to distinguish between certain colours—red, orange and yellow may not be distinguishable from blue, grey, or green, and in some few cases absolute colour-blindness exists, black and white being alone recognized. In other instances the patient complains that all colours present a certain tint either of red, green, or some other colour; but this form of colour-blindness is uncommon, except as a result of disease of the brain or optic nerve, which we shall subsequently have to consider.

Hereditary and incurable.

Certain colours only recognized.

* *Indian Medical Gazette*, August 1, 1868.

Dr. G. Wilson* states, that patients suffering from colour-blindness can often distinguish colours by artificial light better than by daylight; he points out very forcibly the necessity of examining men employed as guards to railway trains, and in other similar situations, as to their power of distinguishing the various colours: a man may be affected with colour-blindness without knowing it, and, if so, he is of course unfit for an employment in which the recognition of coloured signals is all-important. The ability, however, to discern colours, as I have above remarked, is impaired by various affections of the eye.

Importance in case of signal-men.

This defect occurs under every form of nerve-atrophy, as well as in every degree of amblyopia. Even where sight is not much injured colour-blindness may be very marked. The prognosis of the nerve-affection is not modified for better or for worse by the loss of colour-perception. The colour to which patients are most frequently insensitive is red, while blue is best preserved: green appears yellowish or grey; rose and violet, bluish; yellow commonly appears yellow. In the later stages of the malady only the bluish shades are apt to be recognized, all others appearing whitish, grey, or dark. This corresponds closely with what is true of the normal eye during deep twilight.

In three cases of *hemiopia* there was no defect of colour-perception in the sound half of the field. In one of these cases vision was nearly restored, but on the blinded side the colour-sense remained defective. Quaglino and Boys de Loary published each a case of hemiopia in which there was absolute colour-blindness for the remaining field.

In hemiopia.

An extremely interesting class of cases are those of amblyopia without central scotoma or ophthalmoscopic lesions. The amblyopia occurs without central scotoma; and in these cases there is little derangement of the perception of colour. Out of twenty-one cases of amblyopia without scotoma, only three were unable to distinguish red. These patients acquired their amblyopia from abuse of alcohol, tobacco, and other toxic substances, a few from anæmia and mal-nutrition. This assertion appears to be supported by the fact that, out of eighty-one

Rare in amblyopia without central scotoma.

* "Researches on Colour Blindness," pp. 118–127. Edin., 1855.

cases of amblyopia in which there were no ophthalmoscopic lesions and no central scotoma, there were seventy-five men and six women.

Constant with central scotoma.

Cases of amblyopia with visible lesion, and with central scotoma, present marked impairment of sense of colour. At an early stage of these cases is to be found sometimes a faint, striated haziness of the border of the papilla and neighbouring retina, which resembles syphilitic retinitis, but, unlike the latter, extends only a little distance into the retina. Twice there were evidences of diffused retinitis; in several cases there were isolated hæmorrhages; but generally no marked changes could be seen by the ophthalmoscope. At a later period the papilla is apt to show alteration of tissue in pallor or slight bluishness of its outer half —a sign of partial atrophy at least in some of the cases. Of this class of cases fifty-six were seen, and in thirty-one the perception of colour tested; of which in all there was a discernible impairment. So uniform was this fact that it may be taken as a means of diagnosis of the existence of central scotoma.

The following "Suggestions as to International Arrangements for a Uniform System of Maritime, Coast and Harbour Signalling, with a view to the safety of life and property," have been recommended by a committee of the Medical Congress appointed for that purpose :—

A. *With respect to Land.*

"For admission as *Driver* or *Stoker* is required :—A healthy condition as regards habitual congestion or irritation of the eyes and eyelids; *for each eye*, complete field of vision, normal acuity and refraction, colour-sense at least four-fifths of the normal, total absence of commencing cataract or any other progressive disease.

"For admission to other *Railway Service* is required :—A healthy condition as regards habitual congestion or irritation of the eyes and eyelids; *for each eye*, complete field of vision, total absence of cataract, or any other progressive disease; *for one of the eyes*, normal acuity and refraction, colour-sense at least three-fifths of the normal; *for the other eye*, sight of at least half the normal, as regards both acuity and colour-sense.

B. *With Respect to Sea.*

"(2.)—That in *ocean-going ships* and in *all steamers*, especially those carrying passengers, there should always be in actual control of the helm a person possessing *with the two eyes together, without glasses*, normal sight, both as to acuity and colour: and that, *in addition*, in such ships, *at least one* of the persons actually on the look-out should be similarly qualified.

"(3.)—That in vessels engaged in the coasting trade, every person liable to take charge of the helm should possess *with the two eyes together, without glasses*, sight equal to at least two-thirds of the normal, both as to acuity and colours.

"(4.)—That all persons engaged in marine signalling, ashore or afloat, and all pilots, should have have normal sight, both as to acuity and colours, as defined in Article 2.

"(5.)—That hypermetropic persons, although satisfying the requirements of Articles 2, 3, and 4, should nevertheless not be admitted, if before the age of eighteen they have a manifest hypermetropia of 1 dioptre or more.

"(6.)—That re-examinations should be made at the age of forty-five.

"(7.)—That the examinations should be conducted by persons of recognized competency, under the direction of a Central Medical Authority in each country.

"(8.)—That an International Commission should be constituted, to fix upon such further measures as to signals as may be necessary for safe navigation, and specially upon the standard colour, and the sizes of the signals which should be employed.

EXPLANATORY REMARKS.

(The numbers refer to the Resolutions.)

A. *As to Land.*

"(1.)—The signal service on land, though quite as important, are not so purely an international matter as those having reference to the sea. Many countries have already established legislation in this respect, and others are introducing it by

degrees. It is believed that the standards now recommended may be of general utility, especially in the case of conterminous countries. The mode of examination, for colours especially, is here, as for service at sea, of the highest possible importance.

B. *As to Sea.*

"It is obvious that Regulations having an International character become every year more urgently required, from the increasing number, size and speed of vessels.

"In view of the practical difficulties with which all compulsory examinations are attended, it has been sought :—

"(*a.*) To limit the examination in each case to what is strictly necessary.

"(*b.*) To require them only when absolutely indispensable, and of the smallest possible number of persons.

"(*c.*) To simplify the methods as much as possible.

"On large ships, many sailors not required for the helm, or to be responsible for the look-out, may be admitted without certificate of examination : but as it will be in the interest of all to be possessed of such a certificate, which would represent a higher competency, it may be expected that many would themselves seek for it, from whom it would not necessarily be demanded, and facilities for obtaining it should at all times be at hand in maritime ports.

"(2.)—Good sight *without the aid of* glasses is required, because glasses fail to help just where clear sight is most needed—*e.g.*, in storm, rain, or fog.

"*Acuity of Sight* :—Complete acuity is not more than sufficient, and even scarcely sufficient, having regard to the increasing number, size, and speed of steamers. But it will be practically enough, if at sea, this complete acuity is attained by the use of *both eyes combined.* The number of persons excluded under this rule will be much less than if complete acuity for *each eye separately* is needed.

"The acuity is supposed to be determined by viewing letters or signs at a certain distance, under a certain angle, on the principle of the test-types of Snellen.

"*Colour-Sense* is supposed to be tested by pseudo-iso-chro-

matic tables, on the principle of those of Stilling, subject to control by the use of light transmitted through coloured glass, in imitation of signal lights. This control will also aid in detecting central scotoma for colours, in the very rare cases where it might co-exist with the required acuity.

"Holmgren's excellent tests have been already extensively adopted. But their use demands more skill in the examiner. Tests well selected on the principle of Stilling might be very well adopted as standards for ascertaining normal colour-sense, as well as definite degrees of colour-sense below the normal. The principle of Stilling has been recommended as affording a quantitative as well as a rapid qualitative test.

"(3.)—A lower standard is fixed in the coasting trade (excluding steamers) because the vessels are smaller and the speed less. Moreover, a demand for full acuity would render it difficult to procure a sufficient number of sailors, as each hand must be liable in small vessels to serve at the helm.

"(4.)—It is obvious that the persons here named must have full acuity and colour-sense.

"(5.)—Persons having a manifest hypermetropia above that here indicated would not possess, at the age of thirty-five or forty, without glasses, the needful degree of acuity; it is better then, both for themselves and the service, that they should not be admitted at all.

"(6.)—The attendant practical difficulties have caused one re-examination only to be advised at the age of forty-five. It has been found that the very great majority of persons, once admitted as having good sight, have retained it up to that age. A great number, no doubt, have been admitted hitherto without sufficient examination. Still, it would not be practicable to institute a general examination of those already in the service. Nevertheless, it would be desirable to examine anew, in the case of passenger steamers, all those responsible as helmsmen and look-out men.

"The Congress recommends that surgeons of ships should be qualified to exercise special surveillance as to the sight of those employed in these capacities on board.

"(7.)—A central medical authority is requisite to ensure the

perfection of the system, and its uniformity. He should propose the examiners, and be responsible for their fitness. They should be men of ascertained competency, and, as far as practicable, qualified as medical specialists.

"(8.)—The measures recommended in Articles 2 to 7 should be brought into operation without delay. But an International Commission would still have to determine the precise colour of the glass, securing uniformity in that as well as in the size and disposition of the signal lights."

Hemiopia. HEMIOPIA, OR HALF-VISION.—The fibres of the optic tracts meet in the chiasma, those from the outer part of the right tract passing to the outer part of the right retina, and those from the inner part of the right tract supplying the inner half of the left retina; the left optic tract in like manner supplies the outer half of the left retina, and the inner half of the right retina. In consequence of this relation of the fibres of the optic tracts, mechanical causes, such as a clot of blood, or a tumour, interfering with the integrity of either optic tracts, may produce blindness confined to the inner half of one and the outer half of the other eye, while the remainder of both retina may be healthy. The defect in the sight is clearly indicated, and must be carefully mapped out by a close scrutiny of the visual field of both eyes; it is thus only that we can arrive at a correct diagnosis of the case. If the disease be confined to one side of the brain, the limitation of the field of vision is often clearly defined, and should the history of the case point to the formation of a clot as the cause of the affection, we need hardly fear that the impairment of vision will extend; but the majority of these cases depend on tumours involving the chiasma, in which case both tracts are gradually implicated, and the patient's sight hopelessly destroyed. If the hemiopic contractions occur simultaneously, or at a short interval from each other, the corresponding sides of the two retinas being affected, we may ascribe the disease to one root of the optic nerve.

From disease or compression of either optic tract.

By a clot of blood, or tumour.

Homonymous, or lateral hemiopia is, however, exceptional. The temporal halves, and, in rare cases, the nasal, or upper and lower halves of each monocular visual field, are blinded.

Temporal hemiopia is to be explained by hindrances to conduction in the optic fibres, which cross at the chiasma. We have no proof of the existence of other forms.*

In these cases of destruction of the nerve-fibres, occasioned by disease affecting the optic tracts or the brain, abnormal appearances are not often observed in the retina; it is this fact which distinguishes hemiopia resulting from paralysis from that impairment of vision in which half of the retina has been detached or entirely destroyed from an effusion of serum or blood behind it. Retina appears healthy.

Hemiopia sometimes appears as a transient affection, depending upon functional derangement of the retina. Dr. Wollaston's case is an instance of transient hemiopia; he remarks:—"I suddenly found, after violent exercise two or three hours before, that I could see but half the face of a man whom I met; and it was the same with respect to any other object I looked at. In attempting to read the name Johnson over a door, I saw only . . . . son; the commencement of the name was wholly obliterated to my view." In this case the affection passed off in about a quarter of an hour. Functional hemiopia. *Case.*

We meet with instances of this kind from time to time in practice; they generally come on with indigestion or headache, and are of little or no consequence, but may cause the patient much unnecessary alarm. On examining the eye with the ophthalmoscope no abnormal appearance can be discovered, the affection probably depending on temporal loss of power in the nerve-fibres, or nervous matter, supplying half the retina of either eye. In some instances of hemiopia there is a marked defect of colour-perception in the sound half of the visual field. In one case of this kind vision was nearly restored, but on the blind side the colour-sense remained defective. Due to gastric irritation.

*Treatment.*—In that form of disease last described, we must direct our attention towards the removal of the source of irritation, which is usually gastric; but, as I have before remarked, the affection is generally a very transient affair, and it will *Treatment.*

* C. Stellwag von Carion, "Diseases of the Eye." By Hackley and Roosa, New York, 1868, p. 663.

Unsatisfactory in brain cases.

often be unnecessary to prescribe anything for it. In those far graver cases arising from actual destruction of tissue in the optic tracts, or nervous centres, we can seldom do much towards relieving the symptoms. We shall generally have sufficient evidence of the nature of the lesion from various concomitant symptoms, depending upon the disease of the brain, and it is to these our attention should be directed rather than to the state of the retina.

Scotoma. A portion of retina insensible to light.

SCOTOMA (constant) signifies a form of partial blindness, in which only a portion of the retina is insensible to light, and this part often appears as a black speck to the patient, particularly when he is engaged in reading or any similar work. In these cases, the rays of light are not prevented from reaching the retina, but they fall on certain parts of the fundus of the eye incapable of appreciating the stimulus of light, which hence appear as dark spots in the field of vision.

Appears as a black spot.

Moves with the eye.

One of the characteristic features of scotoma is, that the patient observes the dark spots to move exactly with his eyes, and not float about before them, as in *Muscæ volitantes;* thus, for instance, it will appear to follow the eyes as these are cast along the lines of a book in reading or writing, as it were covering a part of the line; in fact, we may generally detect the presence of a scotoma, by making the patient look through a small aperture at a sheet of white paper, upon which he will generally perceive a black spot projected, if a part of his retina is insensible to light. Scotomata vary much in form and figure, being described as discs, lines, stars, and so on.

Its position important.

The position of the scotoma will very much influence its effect on the patient's sight: if at or near the yellow spot it will be most annoying, constantly interfering with the perfection of vision. On the other hand, if the scotoma be eccentric, it may cause but little inconvenience, and hardly any at all in reading or writing; but, when looking at a distant object, the patient will probably notice a hazy or misty appearance over a portion of the field of vision.

*Causes.*

Congenital defect.

Scotoma may arise from congenital defect, a portion of the retina being imperfect or wanting; but these dark spots are far

more commonly the result of a rent in the retina resulting from a blow, or from hæmorrhage or inflammation of the retina and choroid. In this case the ophthalmoscope may reveal to us the nature of the disease; it may be that a spot of atrophied retina, or one infiltrated with choroidal pigment, will thus be seen, and account satisfactorily for the symptoms from which the patient complains. Retinitis.

In other cases scotoma may be induced by injury, perhaps the result of a clot or plug in one of the vessels of the optic nerve, interfering with the integrity of some of the fibres of the nerve, or destruction of a limited portion of the brain; in which case, although the portion of retina supplied by these fibres will be insensible to light, we may be unable to perceive any alteration in the fundus of the eye by means of the ophthalmoscope. In cases of this description, the scotoma generally comes on suddenly, and the affected portion of the retina, if not absolutely insensible to light, may be incapable of appreciating colours; in fact, it often happens that a certain portion of the retina may be affected with colour blindness, in the first instance, and subsequently become dead to the stimulus of light without our being able to detect anything wrong with the eye by means of the ophthalmoscope. Disease of the nerve or brain.

Should a scotoma have been observed by the patient for some considerable time, it is seldom that the black spot subsequently disappears, whether it arises from an affection of the brain or retina, especially if symptoms of commencing atrophy of the disc are present. But if the spot has only recently appeared the case will not be so hopeless, and our prognosis and treatment will be very much guided by the aid which the ophthalmoscope affords us. A central scotoma is always more serious than one, though it may be of large size, in the periphery of the retina. If no morbid changes are detected in the eye, probably the disease depends on some affection of the nerve; or we may suppose that a limited portion only of the optic tract is involved; and in these cases we may hope for some improvement. I need hardly say that no such favourable prognosis can be formed in a case of partial atrophy of the retina, or where its nervous structure has been invaded by pigmentary formations from the Prognosis bad in old cases, or if attended by structural changes.

choroid. On the other hand, absence of atrophic symptoms in the optic nerve or retina does not exclude an unfavourable result.

Clots of blood may disappear.

Blood clots are sometimes a cause of scotoma, and may be detected with the ophthalmoscope; as they are absorbed, the part gradually recovers its functions. The same remark applies to limited serous effusions behind the retina, provided the nervous tissue does not appear to be atrophied, having lost its transparency over the seat of effusion.

Amaurosis and Amblyopia.

AMAUROSIS AND AMBLYOPIA.—In most cases we can assign a definite cause for the impairment or loss of vision from which our patients suffer.

Modern distribution of cases.

Amaurosis, whether complete or incomplete, may be classified under the following divisions :—

I. Ocular (retinal, choroidal, or in the optic nerve).

II. Extra-ocular (orbital).

III. Cerebral or spinal.

This classification seems to meet all the circumstances of these cases.

Ocular cases.

Blindness, whether partial or complete, arising from any of the causes first mentioned, will be found discussed under the heads of disease of the retina, choroid, and optic nerve.

Orbital.

As an instance of the second class, I may refer to the remarks made upon inflammation of the cellular tissue of the orbit inducing atrophy of the optic nerve. Another instance of the kind is amaurosis following wounds and injuries of the supra-orbital nerve. Exophthalmos and its causes all come under this heading, as being either directly or indirectly the cause of amaurosis. Lastly, absolute or total blindness may be induced by intra-cranial tumours pressing on the optic tracts and vessels of the optic nerve, or from apoplexy, softening, or tubercular disease of the brain or its membranes, as well as by injuries involving the base of the brain.

Intra-cranial.

Symptomatic of various dyscrasiæ.

Amaurosis and amblyopia may occur, among other symptoms, in albuminuria, syphilis, diabetes, and embolism, and "during irregular menstruation, pregnancy, parturition, or lactation." In the latter group of cases the affection is usually functional,

and disappears after its exciting cause has been removed. After prolonged lactation, for instance, dimness of vision is often induced by anæmia of the retina, and can only be cured by giving up nursing and resorting to a tonic plan of treatment.

General considerations regarding amaurosis.

Without, however, entering at length into subjects already treated of in previous sections of this work, it seems desirable to make a few further remarks on partial loss of sight (amblyopia), and complete loss of sight (amaurosis).

*Prognosis.*

*Prognosis.*—Amaurosis and amblyopia may arise from mechanical causes, as for instance from a blow on the eye separating the retina from its attachments, and rupturing one or more of the vessels, the hæmorrhagic effusion breaking down the delicate nervous structure of the retina. Similar results may follow hæmorrhage proceeding from the rupture of a diseased vessel. Loss of sight thus produced may improve, especially if the case is a recent one, and the optic disc appears healthy; but if the papilla indicates advancing atrophy the prognosis is most unfavourable. Under this class of cases we may also place instances of embolia of the central artery of the retina.

Mechanical causes.

From loss of blood.

The prognosis in cases of loss of sight occurring after profuse hæmorrhage is generally unfavourable, although cases of complete recovery are recorded.

The same remarks are applicable to instances of *complete* loss of sight following over-suckling. In these instances, it may happen the nutrition of the nerve-elements of the retina have been so much impaired that these delicate structures have undergone irreparable changes leading to loss of vision. On the other hand, it is very common to meet with cases of women who are nursing complaining of loss of sight, which is quickly restored by means of tonics and leaving off nursing.

In pregnancy.

I have seen two cases of amblyopia coming on during pregnancy, in which slight effusion over the optic disc could be detected; the loss of sight was gradual from the seventh month to the time of delivery, and did not subsequently improve. In cases of amblyopia commencing during gestation, although the ophthalmoscope may not demonstrate any marked disease, I should be inclined to give a very cautious prognosis, especially if hæmorrhages were observed in the retina.

Amaurosis in fevers.

In another class of cases of amaurosis, arising apparently from alterations in the condition of the blood, the blindness may be only temporary, such for instance as partial or complete loss of sight after various forms of fever. The blindness usually comes on suddenly, lasting for two or three days, and then returning.

State of the pupil.

But it is remarkable that in many of these instances the pupil responds to the stimulus of light; and this is a significant point as a guide to prognosis, for if the pupil retains its activity, however great the blindness may be, we may, in the above-mentioned cases, offer a favourable prognosis, for the facts indicate that, whatever the cause of the loss of sight, it must be situated between the corpora quadrigemina and that portion of the brain in which the perception of light is localized.

In heart disease.

Cases of a congestive form of amaurosis consequent on disease of the heart may disappear if the disturbance in the circulation subsides. Intra-cranial overloading of the bloodvessels may lead to a similar result, and will be accompanied by symptoms of cerebral hyperæmia; the loss of sight is often very sudden, and may as rapidly recede on the removal of the exciting cause; among such causes may be mentioned interruption of the menses, mental excitement, excessive vomiting, or muscular exertion.

In brain disease

The prognosis is frequently rendered most doubtful, in consequence of the obscure nature of intra-cranial disease. In some few cases atrophy of the disc has become stationary, and recovery may take place from this condition; nevertheless, such cases are extremely rare. We should hardly judge of the condition of the patient's sight from the appearance of the disc; it may happen that the vision is better than the state of the optic disc would lead us to imagine.

Condition of the visual field.

We must carefully examine the state of visual field; and, as a rule, our prognosis will be unfavourable if we discover concentric limitation; the more so, if the lateral limitation is irregular. Stellwag von Carion observes, if hemiopia occurs on the same side of both eyes, and is sharply bounded by the vertical line of separation of both visual fields, and also if it be

Sharp limits favourable.

accompanied by atrophy of the corresponding half of the optic papilla, it is to a certain extent favourable; that is, it is seldom

followed by complete blindness, especially when it has existed for some time unchanged. But if the loss of vision advances with indistinct outlines over the centre of the retina the worst is generally to be feared. In the remaining varieties of hemiopia the conditions are too unfavourable for the limitation of the original disease to enable us to hope for a pause in its progress. Such cases generally go on to complete blindness, with progressive atrophy of the optic nerve.

Small lateral limitations act in about the same way. A further increase is not probable, whether the defect is monocular or symmetrical in both eyes, if it ends in a sharp line far from the centre, and if the relative sharpness of vision be normal in the other parts of the field of vision, and if, besides, the defect has not existed for a very long time. But limitations with very indistinct and irregular borders, with evident diminution of the relative acuteness of vision in the remaining parts of the field, cause us to give the worst prognosis. This is true even if the atrophy be not yet observed. The patient is in a particularly bad state when repeated examination shows a continuous loss of sight, and the appearance of similar defects in the other eye. Then we certainly have a progressive atrophy, which seldom ceases before complete amaurosis results.

Ill-defined ones bad.

Central and eccentric interruptions, when they occur in a visual field which is in other respects normal, are not apt to depend on progressive atrophy. We may exclude the idea of the latter when the interruptions have been of the same extent for a long time. It is all the same, then, whether they exist in one eye or both ; even a partial paleness of the optic papilla does not alter the case. But we generally have a progressive atrophy when they are combined with marked lessening of the relative acuteness of vision in the remaining portions of the visual field, especially when the loss of vision decreases very irregularly in different directions towards the periphery.

Limited interruptions.

*Treatment.*—This must, of course, depend on the cause of the amaurosis ; in one case drugs, in another electricity, may be employed ; and in all, as far as practicable, the state of the patient's general health should be carefully attended to. I may mention one point, and that is with reference to the use of

*Treatment.*

Spectacles. spectacles ; in most forms of amblyopia we may with advantage limit the patient to use the lowest convex glasses he can see with ; and it may very possibly happen that, subsequently, he may be able to get on with a higher power, the sight improving under the use of convex glasses, which not only save a strain on the accommodation of the eye, but increase the clearness of letters and other small objects.

## CHAPTER XIV.

## DISEASES OF THE VITREOUS.

*Hyalitis—Muscæ—Opacity: Syphilitic and Anæmic—Films—Sparkling Synchysis—Hæmorrhage — Entozoa — Foreign Bodies.*

HYALITIS, OR INFLAMMATION OF THE VITREOUS, may be induced by the presence of a foreign body purposely passed through the vitreous chamber.* In instances of this kind, Donders describes changes occurring around the foreign substance, similar to those noticed in other parts of the body during inflammation. HYALITIS. Simple form rare.

These pathological alterations may occasionally be traced when a foreign body, such as a piece of guncap, has accidentally passed into the vitreous. From proliferation of its cells, and those of surrounding structures, the vitreous becomes hazy, the foreign body being enveloped in a greyish layer of opaque material, and branching out from this centre of irritation opaque streaks may be observed. Subsequently, the connective tissue breaks down, and the vitreous having become fluid, thread-like fibres may be seen floating about in it. These instances, however, must be very rare, for in the majority of cases the choroid and retina become involved, and it is then impossible to determine how far the changes observed in the vitreous are due to extraneous sources. Mostly complicated.

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* M. Wecker, "Maladies des Yeux," vol. ii. p. 282.

Posterior hypopion.

Pus doubtless collects at times in the inferior part of the vitreous chamber, especially after the operation of reclination of the lens, forming what is called a posterior hypopion; but I am not disposed to admit the existence of such a disease as idiopathic suppurative hyalitis; in fact, with Dr. H. Pagenstecher, I doubt the correctness of those who describe inflammatory changes under these circumstances. Doubtless we meet with instances in which the vitreous become clouded, rendering the details of the fundus of the eye indistinct, or it may be invisible: but these conditions without question are due to previously existing alterations in the choroid.

Muscæ Volitantes.

MUSCÆ VOLITANTES. — Muscæ volitantes appear to the patient as dark bodies, under various forms, floating about in the field of vision; they are often very annoying, but, unlike scotoma, they do not interfere with the perfection of vision.

Motes in the field of vision.

They appear to the patient to consist at times of slender rings, which seem to ascend from the lower part of the field of vision and then to fall down again. In other cases they take the form of pearly strings, which twist and twine about in all directions, or they may be seen as fine bands hovering about in the visual field. They are most distinctly noticed when the patient looks at some clear bright object, as, for instance, at the sky or a white wall; in a dim light they are probably not visible. After overworking the eye the dark bodies are very apparent, and also if the digestive organs are out of order.

Shadows of cells and films in vitreous.

These various appearances are due to the presence of minute pale cells, or of granular fibres or shreds in the vitreous humour,* and the shadows which these cast on the retina are the direct cause of the muscæ volitantes noticed by the patient in the field of vision. In some few instances it appears that opaque globular spots, situated among the fibres of the lens, may, by intercepting the rays of light falling on the retina, produce the appearance of muscæ volitantes.

* "Accommodation and Refraction of the Eye," by F. C. Donders, p. 199: Translated by Dr. Moore: New Sydenham Society.

Muscæ, therefore, are by no means a symptom of any great consequence, and are often observed in persons whose eyes are otherwise healthy. The cells and filaments of muscæ volitantes are too minute to be seen with the ophthalmoscope, and are thus distinguished from opaque membranes floating about in a fluid vitreous, which may be detected without any difficulty with the ophthalmoscope, and which are invariably pathological products, and therefore a matter of serious consideration. Short-sighted persons are very apt to suffer from muscæ, in consequence of the increased circles of diffusion cast by the minute bodies on the retina; we may comfort such patients with the assurance that the muscæ are not a symptom of serious disease. Of small consequence.

Muscæ differ from scotomata (p. 386) in that the latter follow the movements of the eye, as dark spots along the lines of a page in reading and writing, and do not float about as ill-defined shadows, an appearance characteristic of muscæ volitantes. Moreover, in the case of scotomata, the ophthalmoscope usually enables us to detect abnormalities in the retina, which account for the "dark spot" noticed by the patient. How differing from scotoma.

*Treatment.*—It will often be found that cases of muscæ depend on gastric derangement, or at any rate occur when the stomach or liver is out of order; and a little attention bestowed on these organs will do much towards removing the muscæ. In other cases, rest and a tonic plan of treatment are of service. Lastly, it should be remembered that muscæ sometimes remain stationary for years, and then disappear of themselves. Tinted glasses often prove useful to patients suffering from muscæ. *Treatment.* Correct gastric disorder.

OPACITIES OF THE VITREOUS.—Opacity of the vitreous varies in its degree from a cloudiness to that of opacity, so dense, that we cannot see the optic disc through it: this condition of the vitreous is present to a slight degree in many cases of glaucoma depending on hypersection of serous fluid into the vitreous chamber. Opacity of the vitreous is most commonly met with, however, as a sequence of disease of the choroid, often the result of either inherited or acquired syphilis. Excluding this class of cases, opacity of the vitreous is most commonly seen among patients suffering from sclero-choroiditis posterior. OPACITY OF VITREOUS. Generally syphilitic.

Another cause of opacity of the vitreous is extravasation of blood from rupture of one or more of the choroidal vessels.

Changes in vitreous slow.

If depending on inherited syphilis, the changes in the vitreous usually take place slowly, and the structure may at any time gradually clear and become transparent; on the other hand, if the degenerative process continues, it may lose its consistency, and pass into a fluid state. Flocculent masses will then be seen floating about in it; while, from the loss of the support which, under ordinary circumstances, the vitreous affords the retinal vessels, they may give way, and blood become effused in the retina. These abnormal changes, under the circumstances, generally commence when the patient is about eighteen years of age. The disease is accompanied with no pain in the eye, and the patient complains of no inconvenience beyond the gradually increasing loss of sight, which is most marked after sunset. At first, therefore, the symptoms are apt to be neglected. On making an ophthalmoscopic examination, the real nature of the disease will be discovered.

When from hereditary syphilis, sets in about age of eighteen.

May be overlooked.

Examine by direct process,

Changes in these structures are most readily detected by the direct process of examination; in fact, we should always make a point of examining an eye by this means before using the indirect method; a fluid or hazy vitreous may be overlooked for want of this precaution. If, however, there is any doubt in our mind as to the condition of the lens, we should invariably employ lateral illumination; by this means it is almost always possible accurately to define structural changes in the lens or cornea. In the majority of cases of incipient cataract we shall discover one or two landmarks of this description.

and lateral illumination.

Patchy opacity of the fundus,

In examining cases of syphilitic opacity of the vitreous, we may frequently notice that the fundus of the eye appears to be deeply opaque in patches, situated apparently behind the vitreous; this condition of the parts is generally caused by disease of the retina and choroid. It is very rare to find the vitreous itself so densely opaque as entirely to obscure the reflection of light from the fundus of the eye: a dull, foggy glimmer from the retina may almost always be noticed through the diseased humour. But when, in addition to this, the reflections from definite portions of the fundus are particularly dull,

we must be guarded in our prognosis; it is more than probable that in such cases, if the vitreous clears, we shall discover further mischief to have taken place behind it, in the retina or choroid. from changes retina or choroid.

FILMS IN THE VITREOUS.—Occasionally colourless floccu- FILMS IN VITREOUS.
lent bodies or films are seen stretched across the vitreous chamber, like a thin veil in front of the retina. These consist, probably, of the cellular structure of the vitreous, rendered opaque by degenerative changes. Professor von Graefe has removed opacities of this kind by passing two needles into them, May be broken down.
and breaking them down, in the same way as Mr. Bowman directs for the removal of an opaque capsule from behind the pupil.*

Another cause of opacity of the vitreous is the effusion of blood into this chamber, as I shall presently explain more fully.

SPARKLING SYNCHYSIS.—A remarkable condition of the SPARKLING SYNCHYSIS.
vitreous, called sparkling synchysis, is occasionally seen, depending upon the presence of innumerable particles of cholesterine floating about in it. With the ophthalmoscope, they appear like a multitude of grains of gold-leaf, whisking about in all directions when the eye is turned quickly from one side to the other.

This condition generally arises from degenerative changes From degenerate lens.
taking place in a dislocated lens; a great part of the lenticular matter becoming absorbed, the insoluble cholesterine is left in the vitreous chamber.

Among the natives of India these appearances are sometimes seen, in consequence of the lens having been thrust down into the vitreous, in the operation of depression or reclination for the cure of cataract. We not unfrequently have patients applying for relief at the Ophthalmic Hospital under these circumstances, suffering from atrophy of the retina and choroid, together with sparkling synchysis.

* Carter's translation of Zander "On the Ophthalmoscope," p. 224.

Blood in the Vitreous.

Hæmorrhage into the Vitreous.—It is by no means uncommon to meet with cases in which an effusion of blood into the vitreous has taken place, in consequence of a blow, or from rupture of diseased vessels in the choroid or retina. For instance, a person is struck on the eye, and he finds that he cannot see clearly, the field of vision being obscured by a reddish haze. With the ophthalmoscope, the vitreous appears of a diffused, bright scarlet colour, the optic disc being dimly seen through it; spots of ecchymosis will probably also be observed in the retina.

From blows or diseased vessels.

Appearances.

Quickly absorbed.

The effused blood may be rapidly absorbed, and the vitreous return to its normal state of transparency; but if the hæmorrhage has been at all profuse, a clot may form in the axis of vision, rendering the patient more or less blind. The fibrine of a clot of this kind usually undergoes fatty degeneration, and gradually becomes absorbed; but hæmorrhage into the vitreous may lead to opacity and further degeneration, and consequent fluidity of that structure; on this account we should be guarded in giving a favourable prognosis in such a case: moreover, the clot may remain *in situ;* and should it even disappear, we may subsequently discover that considerable injury has been done to the retina, and that its functions have become permanently impaired.

A central clot may impair sight.

*Diagnosis.*

There can seldom be any difficulty in forming a correct opinion with respect to the nature of a lesion of this kind; for if the hæmorrhage has occurred in consequence of an injury, the impairment of vision will have originated at the time the blow was inflicted; but if from the effects of disease, the history and symptoms, together with the ophthalmoscopic appearances of the part, will sufficiently determine the diagnosis. It is possible that a malignant growth in its earliest stages, or a separation of the retina from the choroid, might be mistaken for a clot of blood in the vitreous chamber; a little care, however, bestowed on the inspection of the part, will speedily remove any doubt there may have been on the subject. If the case should be one of malignant tumour, the aspect of the excrescence can hardly be mistaken, the pain and tension of

A malignant growth mistaken for a clot.

Distinguished by its history and form.

the eyeball, combined with the ophthalmoscopic appearances indicating the serious nature of the mischief going on in the eye. By means of the lateral method of examination, the tumour may generally be defined as soon as it projects slightly beyond the plane of the fundus of the eye.

ENTOZOA IN THE VITREOUS.—Cysticerci are occasionally found in the vitreous chamber, the cyst in which they grow being attached to the retina or choroid. Dr. Liebreich states that the entozoon is first developed behind the retina, and having perforated it, enters the vitreous chamber. A contracting and elongating movement of the cyst may be clearly observed, though the parasite itself cannot be distinctly seen, on account of the opaque sheath in which it is contained. After a time the cyst bursts, and the head and neck of the creature may then be defined. It is, however, remarkable that, up to this stage of the disease, the parasite appears to cause no inconvenience beyond the shadow cast by the wavy motion of the cyst in front of the patient's retina; there is no pain or irritation in the eye.

Entozoa. Hydatid cysts. Cause little trouble for a time.

Dr. Liebreich relates a case of a cysticercus in the vitreous, which he not only diagnosed, but removed: passing a pair of canula forceps into the vitreous, he seized the parasite and withdrew it from the eye. During the operation he contrived to illuminate the vitreous with an ophthalmoscope which he fixed to his forehead, enabling him to use both his hands, and thus accomplish the necessary manipulation.* Cases of a similar kind have from time to time being recorded;† in some the lens was first extracted, and subsequently the parasite removed; these operations, however, have not been very successful.

Liebreich's case. Successful removal.

FOREIGN BODIES.—The ophthalmoscope is of the greatest assistance in enabling us to estimate correctly the position of

Foreign Bodies in Vitreous.

* "Atlas d'Ophthalmoscopie," par le Dr. R. Liebreich, p. 18.

† Carter's translation of Zander, p. 162.

foreign bodies in the vitreous, and there is no class of cases that demand our more earnest consideration, for the sight of both eyes is frequently compromised, the one by direct injury, the other from sympathetic irritation. As an instance of the aid afforded by the ophthalmoscope, we may refer to a case in which a small particle of steel had penetrated the upper eyelid and sclerotic, and entered the vitreous chamber. The patient was under Mr. Dixon's care, and on examining the eye with the ophthalmoscope, he was enabled to detect the foreign body behind the lens. Mr. Dixon removed it by perforating the sclerotic at its lower and outer part, and passing a pair of canula forceps into the vitreous, with which he caught hold of the foreign substance and so withdrew it from the eye. The patient made a rapid recovery.

Detected with the ophthalmoscope.

Should be removed without delay.

It is impossible to lay down special rules in treating accidents of this kind ; almost every instance we meet will require some peculiar manipulation, and we must exercise our own judgment, ingenuity and mechanical skill in contriving the most appropriate means for accomplishing our purpose. With the ophthalmoscope, a foreign body may usually be defined, if sought for soon after it has penetrated the vitreous chamber ; but after remaining there for some time, it is likely to become hidden by a covering of false membrane.

After a time become hidden.

In India we constantly meet with instances of a foreign body in the vitreous in the shape of a dislocated lens, for the uneducated native practitioners usually operate for the cure of cataract by reclination. Suppose a patient is brought to us in great agony, with his eye violently inflamed from a recently performed operation for depression. On examination, we see the opaque lens bobbing about behind the iris, and it is necessary to decide at once as to the treatment to be pursued under the circumstances. If the lens has been depressed within a week or so, and the patient has still some perception of light, we should attempt to save the eye, removing the lens by linear extraction. We may experience some difficulty in accomplishing this, on account of the adhesions which will probably have formed between the iris and the lens. If the dislocation has existed for

A dislocated lens in the vitreous.

Excites severe inflammation.

Should be extracted if recent.

more than fourteen days, and the patient is suffering from considerable pain in the eye, and has lost all perception of light, it is better to excise the eye-ball at once ; any palliative treatment we may adopt must expose the patient to the risk of losing the other eye from sympathetic irritation ; and there is no chance of the diseased one being in future anything but a source of annoyance and pain, so that the sooner it is removed the better.

Excise globe of eye.

## CHAPTER XV.

## DISEASES OF THE LENS.

*Pathology of Cataract—Lenticular Cataracts—Soft—Cortical—Hard—Treatment—Preparation of Patient—Operation—Depression—Solution—Flap Extraction—Modifications—Linear Extraction—Traction Operation—Modified Linear Extraction—Linear Extraction without Iridectomy—Choice of an Operation—Capsular Cataract—Traumatic Cataract—Dislocations of the Lens.*

### CATARACT.

CATARACT. An opacity of the lens, other structures being healthy.

THE term cataract in the following pages is restricted to instances of opacity of the lens in which, so far as we can ascertain, no disease exists in any of the other structures of the eye. In fact, the symptoms of cataract are gradually increasing dimness of vision, which is accounted for by advancing opacity of the lens due to regressive metamorphosis of its elements. If the opacity, however, is situated in the capsule, the term capsular cataract is employed.

*Causes.*

*Causes.*—The causes of cataract, excluding traumatic and capsular cataracts, have long been a subject of controversy. It is possible that, in some instances, alterations in the constituents of the blood have a direct influence on the formation of cataracts, as, for example, in diabetes ; nevertheless, it is a mistake to fancy that persons suffering from diabetes are peculiarly subject to cataract ; and it is a still greater mistake to suppose such persons do not frequently make good recoveries after operations for the removal of the lens.

Lenticular cataract consists either of fatty degeneration or of scleroses of the lens fibres, and these conditions may be induced by senile changes or through causes affecting its nutrition, whether arising from alterations in the blood, from defective innervation, or by mechanical separation from its attachments.

Spontaneous cataract, fatty.

In cases of traumatic cataract changes occur in the cells lining the capsule, these give rise to rapidly increasing cell-growths, and as this process advances, alterations take place in the nucleus of the lens, which becomes opaque, and lastly, its cortical substance is involved in the degeneration.

Traumatic cataract.

*Classification of Cataracts.*—Cataracts may be divided into two classes, the lenticular and capsular :—

Classification of cataracts.

LENTICULAR CATARACTS may be described under four heads : the soft, cortical or mixed, senile or hard, and zonular cataracts.

LENTICULAR CATARACTS.

1. *Soft Cataract* is most commonly met with among infants and people under thirty years of age.

1. Soft cataract. In the young.

In instances of soft cataract the fibres of the lens not only undergo fatty degeneration, but are disintegrated and broken up. The contents of the capsule being fluid, it bulges forwards, pushing the iris before it, and lessening the antero-posterior diameter of the aqueous chamber.

Contents of capsule fluid.

It is hardly possible to mistake this form of cataract ; the pupil being fully dilated with atropine, the opaque lens appears like a bladder full of creamy fluid, being free from striæ, whether examined by direct or transmitted light. A few opaque or chalky-looking spots are occasionally noticed on the inner surface of the capsule, and now and then flakes of cholesterine may be seen in it. On examination with the ophthalmoscope it will be found that the opacity reaches to the circumference of the lens.

Looks like cream.

Opacity extends to margin.

It sometimes happens that the contents of the capsule when fluid are gradually absorbed, with the exception of a small quantity of its earthy material ; at the same time the capsule shrinks, so that ultimately we notice a white, irregular-looking membrane, situated behind the pupil, and by transmitted light its surface appears wrinkled. The opacity seems to be placed at

May be absorbed,

leaving an opaque membrane.

some little distance behind the iris, a space evidently existing between the pupil and the opaque membrane.

Often tough.

The remains of a soft cataract of this kind are generally tough, and the elasticity of the capsule having been greatly impaired, or lost, it is difficult to destroy these membranes with a needle; they are better taken away by opening the anterior chamber, and, having seized the opaque capsule with a pair of forceps, it may be very carefully withdrawn from the eye.

Striæ begin at circumference.

2. *Cortical, or Mixed Cataract.*—The first appearance of a cortical cataract is generally observed as a series of striæ, commencing at the circumference of the lens and converging towards its centre. The striæ are often situated in the posterior layers or substance of the lens, and therefore at some distance behind the iris; the pupil having been dilated with atropine, this condition is best seen by the direct method of examination, or by lateral illumination. As the cataract advances, the striæ increase in breadth and length, and become of a whitish colour; the younger the patient, and the more rapid the advance of the cataract, the broader and more mother-of-pearl-like the opaque bands in the lens appear.

When fully formed, the iris lies on the cataract.

A fully formed cortical cataract presents the following appearances: when not dilated, the pupil lies immediately on the opaque lens, the degenerated cortical substance extending up to the anterior capsule. The pupil having been dilated with atropine, the lens appears uniformly opaque, and is marked with

Opal-like bands.

bands of mother-of-pearl or opal-like appearance; the centre of the lens may present a slightly yellowish tint, and by transmitted light it will be seen to be of a denser consistency than

Margin of lens less dense.

its circumference. This point is best determined, however, by the ophthalmoscope; with the aid of this instrument we shall discover that the margin of the lens allows a certain amount o

Allows a reflection from the retina.

light to pass through it, and a reddish reflection may be observed from the back of the eye. The denser central portion of the lens, however, entirely obstructs the rays of light from reaching the choroid, and appears as an opaque mass, surrounded by a dim reflection from the fundus through the circumference of the lens.

If a cortical cataract forms in the lens of a patient advanced in life, or is of long standing, the fibrous bands of the cortical substance are less marked, and the centre of the lens (its nucleus) assumes a more decidedly amber tint.

3. *Senile, or Hard Cataract.*—One of the difficulties we meet with in tracing the characteristic appearances of a senile cataract, arises from the slow invasion and indefinite character of the disease in its early stages. As a person advances in life, senile changes take place in the lens by which its nucleus is rendered amber-coloured and in some degree opaque, and yet the individual may possess very good sight, at most being only presbyopic, and is not considered to have cataract; but if this degeneration advances, and the nucleus of the lens becomes sufficiently opaque to prevent the rays of light from reaching the retina, a senile cataract is then said to exist.

3. Senile cataract.

Lens opaque with age.

This form of cataract seldom occurs in a patient under forty-five years of age. In its early stages the lens presents a yellowish, or amber colour, most marked in its centre, and a clear space may be seen to exist between the iris and the opacity, the cortical substance of the lens being comparatively unaffected. On dilating the pupil, we shall notice striæ, extending from the circumference towards the axis of the lens. As the disease advances the striæ become deeper and more distinct, but still the prominent feature in the lens is its amber-coloured centre, which is indeed the principal characteristic of a hard cataract. On examination with the ophthalmoscope, the circumference of the lens will be found to be less opaque than its nucleus, and a faint reflection from the fundus of the eye will be seen if the pupil is completely dilated. It is in consequence of the nucleus of the lens being most early involved in cases of this kind, that patients often see better after sunset, or when the pupil is dilated, so that rays of light can pass through the margin of the lens to the retina. A weak solution of atropine, if applied to the eye once or twice a week, by keeping the pupil dilated, may enable such a person to walk about, or even read and write with comfort.

Rare before forty-five.

Characteristic amber nucleus.

Striæ.

Cortex semi-transparent.

In these cases of senile cataract, we may frequently observe

Capsule spotted and adherent.

faint spots on the inner surface of the capsule; they consist of fatty epithelium; and as the degenerative changes advance in the cells of the capsule, it becomes firmly glued down to the cortical substance of the lens.

May take a long time to form.

The length of time which a senile cataract may take to form is very uncertain. We are frequently pressed by patients to state how long they are likely to be able to read, or get about by the aid of the affected eye; but we must carefully avoid committing ourselves to an opinion on these matters, for itis quite im possible to determine how long these senile changes in the lens may continue without producing actual blindness.

4. Zonular cataract. Often congenital.

4. *Zonular Cataract* most frequently depends on hereditary syphilis, and is a congenital affection.

In infancy, opacities of the lens of this description may be overlooked, the child not showing any signs of defective vision until he is about two years old, when he begins to employ his eyes on small objects; even then he may see fairly well. The opacity of the lens in zonular cataract is situated between its posterior cortical layers and the nucleus; it is seen, therefore, at some distance behind the pupil, the anterior cortical substance and the nucleus intervening between the opacity and the iris.

Compatible with useful vision.

Situated in posterior layers of the lens.

The pupil having been dilated with atropine, a whitish-grey film is observed in the lens in the position above indicated, looking very much as though a piece of silver-paper had been stuck on to the posterior surface of the lens. The opacity is always greatest in the axis of vision, often appearing to be of a chalky consistency, with striæ radiating outwards from this central portion; the circumference of the lens is frequently transparent.

Opacity greatest in the axis.

These cases of zonular cataract may be divided into two classes, the stationary and the progressive. In the former, the opacity is always well-defined, small, and the circumference of the lens transparent. If a zonular cataract presents appearances of this kind, we may be almost certain that it will not advance for years, or it may be for life. On the other hand, if, in

Stationary form.

addition to the central opacity, we notice that the circumference of the lens is marked with small opaque dots, or striæ, we may be sure that the cataract will progress, and we must plan our treatment accordingly. These streaks and spots in the cortical substance of the lens are best seen by means of the lateral method of illumination. Progressive.

Several other rare forms of cataract have been described; among these *black cataract* has held a prominent place; this form of opacity of the lens appears to arise from an infiltration of hæmatine into the opaque lens,* and often indicates some deep-seated disease of the eye; choroido-retinitis has more than once been observed after extracting such a lens. Black cataract.

The *calcareous, or bony cataract*, is another rare form of disease, the lens undergoing calcareous degeneration similar to that met with in other parts of the body. Bony cataract.

## TREATMENT OF LENTICULAR CATARACT.

PRELIMINARY EXAMINATION.—Before describing the operations usually resorted to for the removal of an opaque lens, it is desirable to refer to certain preliminary considerations which should precede any operative interference, and the result of which inquiry must guide us in the choice of an operation, and the general management of the case. We should endeavour to ascertain the form of cataract we have to treat—first, as to its consistency, and secondly, as to the extent of the cortical portion involved: and lastly, we should investigate the condition of the patient's general health. Treatment of Lenticular Cataract. Preliminary inquiry.

1. *As to the Nature of the Cataract.*—There can be no difficulty in the diagnosis of a zonular cataract; but a question may arise whether the cataract is a fluid or a cortical one; doubtless in some cases the two forms of cataract run into one another, and its character may then be obscure. But the pupil having been dilated with atropine, if the anterior surface of the 1. Nature of the cataract. Zonular unmistakable. Diagnosis of soft.

* "Maladies des Yeux:" L. A. Desmarres, t. iii. p. 72.

lens appears to bulge forwards, the lens being uniformly opaque, and of a cream colour, no striæ, or only faint ones, being visible on its surface when examined by transmitted light; when, moreover, with the ophthalmoscope, we find the lens densely opaque up to its circumference,—under these circumstances, we may safely predict that the contents of the capsule are fluid.

Cortical known by its striæ.

The cortical cataract, when fully formed, presents the mother-of-pearl-like striæ, or bands, on its surface, which are characteristic of this form of opacity of the lens; but the opaline, fatty cortical substance may often enclose a hard nucleus, especially if the patient is upwards of forty-five years of age. We must always carefully examine an eye affected with apparently cortical cataract by transmitted light, and if we detect an amber tinge in its central part, we may expect that its nucleus is a hard one.

Nucleus may be hard.

Senile amber-coloured.

Lastly, the amber colour of the senile cataract is hardly to be mistaken, especially if striæ are seen radiating inwards from its circumference, and if on examination with the ophthalmoscope we find the centre of the lens densely opaque, while its outer part permits rays of light to pass through it from the choroid.

2. Ascertain extent.

2. *Extent of the Cataract.*—Having formed our opinion as to the nature of the cataract, the next question is as to the extent to which the lens is involved;—is the whole of its cortical substance opaque or not? It is of considerable importance to determine this point, because, if the cortical substance of the lens is still transparent, during the extraction of the cataract the cortical matter may become detached and entangled in the iris, and, escaping our notice, it may subsequently set up inflammation in the part, and cause dangerous hyperaction in the deeper structures of the eye; in fact, this is the cause of failure in most of those cases of extraction which are unsuccessful. It is for this reason also we hesitate to operate before a cataract is fully formed. If the whole of the cortical substance is opaque, we shall more easily see any fragments of the lens which may happen to be left in the anterior chamber, and may generally remove them with the scoop, unless they become attached to the posterior surface of the iris.

Transparent fragments dangerous.

The best means we have of ascertaining the extent of the

cortical substance implicated is, to examine the eye by transmitted light, noticing if the free margin of the iris appears to be in contact with the opaque lens, or if there is a space between the undilated pupil and the cataract; in the former case the anterior part of the cortical substance is evidently opaque; but if the iris appears at a distance from the cataract, some of the cortical substance of the lens is still transparent. Is a space seen between iris and cataract?

Where the cataract has been long forming, and therefore causing considerable impairment of vision, but the cortex of the lens has not become wholly involved, I am in the habit of puncturing the capsule with a needle, and thus accelerating the degenerative process; or it may be a case of this kind is better treated by extracting the lens in its capsule, so that none of the soft and transparent cortical matter can attach itself to the iris. Proposal to hasten formation.

Another important question is likely to arise regarding the maturity of a cataract. Supposing that in one eye the lens is opaque, and in the other tolerably transparent, should we wait till both eyes are equally involved before operating, or should we remove the cataract at once? In cases of this kind, I have of late years been in the habit of performing the operation for solution in the eye affected with cataract. By this means, even in cases of senile cataract, the lens is often absorbed before the second eye has become blind. If one lens only is opaque, operate for solution.

It may be laid down as a general rule, that, when both eyes are involved, only one should be operated on at a time, unless in cases of double traumatic cataract, when we should do well to relieve both eyes as soon as possible from the irritation induced by the swollen and opaque lenses. Operate on one eye only at a time.

3. *Complications.*—Before undertaking an operation for the cure of cataract we must be fully satisfied that the case is one of uncomplicated opacity of the lens. It is not necessary for me to recapitulate the characteristic symptoms of glaucoma, choroiditis, cyclitis, and such like diseases, which implicate the lens, and render it more or less opaque, because I have distinctly defined cataract to be an opacity of the lens arising from no such assignable causes. It is desirable to determine, before operating for cataract, the amount of vision the patient pos- 3. Ascertain the absence of other disease. Test the amount of vision

sesses, for it may happen that, in addition to the cataract, he has atrophy of the disc, or detachment of the retina—conditions which we could not ascertain by any external symptoms, and which may have come on so gradually that the patient himself may be unaware of there being any complication of the kind.

by dilating the pupil

To determine the amount of vision, the pupil must be fully dilated with atropine; and I may here remark that *if a patient's pupil does not dilate readily on the application of atropine to the eye, it is an unfavourable sign*, the choroid, or iris, being very probably compromised.

and using a light in a dark room.

The action of the mydriatic being fully established, the patient is to be taken into a dark room, and the flame of a lamp held at various distances, and in different positions with respect to the eye; if he sees the flame with tolerable distinctness in all directions, particularly above and below the eye, we may be pretty certain that no detachment of the retina exists, and that the optic nerve is healthy (p. 31).

4. Inquire as to general health.

4. *General Health.*—We must also take the circumstances of the patient's general condition and state of health into our consideration before operating for cataract; if weak, or otherwise out of sorts, we must put off the operation until his health improves. The existence of chronic bronchitis is especially against the success of the operation.

If good, no preparation.

All that can be said on this subject is, do not operate if the patient is not in his usual state of health, and if he is, the less preparatory treatment he has the better, unless we propose administering anæsthetics during the operation.

PREPARATION.

PREPARATION OF THE PATIENT.—As I have above stated, the immediate preparation on the part of the patient will depend upon whether we are going to administer ether while operating or not; if not, the less we interfere with his usual habits the better.

in case of ether.

*Ether.*—If we propose giving ether or chloroform, it is well to prescribe a mild purgative the day before the operation. Operate, if possible, the following morning, the patient having taken a light breakfast at least three hours before ether is administered, so as to prevent vomiting after the anæsthetic.

With regard to the advisability of administering ether during

the various operations for extracting the lens. The principal arguments against its use are, that people have died under its influence, and that it is likely to be followed by vomiting. The first of these objections, if valid, is equally applicable to other operations, and is hardly tenable at the present day; and as to vomiting after ether, if the patient is previously prepared, it seldom occurs, and should vomiting take place, a pad and bandage secured over the eye immediately after the operation usually prevents injurious consequences. But I may add that a subcutaneous injection of morphia immediately before administering the ether will almost certainly prevent vomiting, especially if used in addition to the preparatory measures above described.

Objections to ether.

On the other hand, it may be urged, that during extraction it is most important to have the patient absolutely passive and free from pain, and an anæsthetic renders the operation a comparatively easy proceeding, and therefore increases the chance of success; and lastly, it saves the patient some suffering and anxiety.

Advantages greatly preponderate.

Upon one point I would strongly insist; it is this—that the patient should be rendered absolutely and completely insensible; both sensation and reflex action must be totally in abeyance during the time we are operating, otherwise it is far better not to give anæsthetics.

Anæsthesia should be complete.

I can say with confidence, operate when your patient is fully under the influence of ether, and then, with ordinary care, your success will be greater than without anæsthetics.

## Operations.

Operation of Solution.

The Operation of Solution or Absorption.—The pain caused by this operation is not sufficient to necessitate the administration of anæsthetics. The pupil having been fully dilated with atropine, and the patient laid on his back on a convenient couch, in front of a good light, the eyelids are to be separated with a stop-speculum, and the surgeon, standing or sitting behind his patient's head, passes a needle rather obliquely through the cornea at a point just within the position of the fully dilated pupil, puncturing the centre of the anterior capsule and cortical

Directions.

Central perforation of capsule and cortex.

substance of the lens. No pressure should be exercised on the lens, or we may push it back into the vitreous chamber; this may be avoided by using the needle as a drill, rotating its handle gently, so as to bore a hole through the capsule and into the lens. As the needle is being withdrawn from the lens, the capsule may be torn open to about the extent of the undilated pupil.

"Drilling."

The size of the opening thus made in the capsule must, however, depend upon the nature of its contents: if fluid, we may freely incise the capsule, and allow the soft lenticular matter to escape into the anterior chamber; but, as a general rule, we cannot be too cautious in lacerating the capsule; it is far better to have to repeat the operation than to do too much at one time.

Avoid doing too much at once.

In the majority of cases, the needle will have to be used as above described several times, at intervals varying from a month to six weeks; but it may be laid down as a rule, that so long as the eye remains at all irritable after one operation, a second operation should not be attempted: among persons advanced in life it frequently takes a year before the whole of the lens is absorbed. At each fresh operation the needle may be more deeply drilled into the lens; but, as I have before remarked, we can hardly exercise too much caution in these cases; for if any of the lens substance escapes through the opening we have made in the capsule, and attaches itself to the iris, it may set up violent inflammation, rendering it necessary for us to remove the lens at once, or it is just possible we may succeed in introducing a small scoop through a wound in the cornea, and extracting the offending particle from the eye.

The operation must be repeated.

Absorption tedious.

I do not think it advisable in such cases to attempt a palliative plan of treatment for more than a few days; if our efforts to stop the inflammatory action, by the removal of the source of irritation with a small scoop, and subsequently by the frequent instillation of atropine, prove unavailing, we should proceed at once to extract the lens, at the same time performing an iridectomy.

If inflammation occurs, remove the lens.

Provided no complications occur, the after-treatment of an ordinary needle operation is simple enough. As a matter of

After-treatment.

precaution, the eyes had better be closed for a few days, and the patient placed in a dark room; the pupil of the eye operated on should be kept fully dilated with atropine, and if no irritation occurs, the patient may be allowed to go about as usual in four or five days after the operation, keeping the eye closed, however, and the pupil dilated with atropine for a fortnight. As soon as all irritation has passed we must drill the lens again; in cases of hard cataract we may have to introduce the needle six or eight times.

Suction Operation.

THE SUCTION OPERATION.—This proceeding may be employed as an adjunct to the needle operation; that is, the capsule must first be freely opened, and the aqueous allowed to gain access to the lens, which rapidly undergoes degenerative changes, and after an interval of a few days may be removed with a Teale's suction instrument,* or with a Bowman's syringe.

Accessory to the last.

Directions for using the syringe.

This instrument is to be used as follows:—The pupil being well dilated, a puncture is to be made in the cornea with a broad needle, opposite the fully dilated pupil; the needle should be thrust obliquely through the cornea, and the opening must be sufficiently large to admit the entrance of the nozzle of the suction instrument; the capsule having been freely divided, the curette must be gently buried in the opaque matter of the lens, our object being to break up the lens as far as possible without in any way displacing or irritating any of the surrounding structures. The nozzle of the suction syringe is then to be passed into the soft lenticular matter, and the piston being gently raised, the lens substance is sucked into the syringe so long as any opaque matter comes forward into the pupil. Care must be taken to keep the open end of the syringe well away from the iris, otherwise the iris may be drawn into the instrument and get bruised or injured.

Avoid the iris.

No delay necessary in fluid cataract.

In cases of fluid or very soft cataract, there will be no necessity for waiting for a few days after the capsule has been opened, but the wound in the cornea having been then and there enlarged,

* *Ophthalmic Hospital Reports*, vol. iv. p. 197.

the suction instrument is to be introduced, and the opaque matter removed as above described.

THE FLAP OPERATION.

EXTRACTION OF THE LENS BY THE FLAP OPERATION.—I have already stated my convictions as to the advisability of administering anæsthetics in operating by flap-extraction for the removal of an opaque lens.

Anæsthetics should be given.

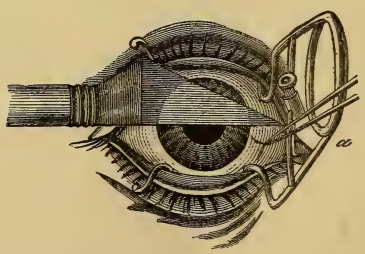
*1st Stage.*

*1st Stage.*—The employment or rejection of anæsthetics makes some little difference in the manipulation necessary in the first stage of the operation, for no one operating with the patient under the influence of ether would think of making his section without first having fixed the eye to be operated on, by means of forceps; whereas, if anæsthetics are not given, I think it is better not to attempt to fix the eye in this way, as the proceeding causes the patient a good deal of pain, and may make him strain more than is desirable while we are making the section in the cornea.

I. Directions for operating under ether.

1. Supposing the patient to be fully under the influence of ether, and laid on his back upon a convenient couch, with his

FIG. 52.




head slightly raised and facing a clear bright light, which should fall obliquely on his face, and not from above, otherwise the surgeon, in bending over his work, will throw a deep shadow upon the patient's eye, which will prevent him from clearly seeing any flakes of lenticular matter or capsule left in the eye after the removal of the lens. A stop speculum should be adjusted as represented in Fig. 52, the end of the instrument, *a*,

resting against the nose. The surgeon, standing behind his patient, with the left hand seizes, with a pair of toothed forceps, a fold of the inner and lower part of the conjunctiva, near the cornea, so as to steady the globe. The eyeball being fixed, be quite certain that your patient is fully under the influence of ether. The surgeon holds Beer's cataract knife in his right hand as he would a pen in writing, his little or ring finger being placed against the patient's temple, so as to support and steady his hand. The point of the instrument is then to be passed through the cornea near the extremity of its horizontal diameter, and about a quarter of a line from its margin, so as to be fairly within the structure of the cornea; the blade, when once introduced, is to be thrust steadily across the anterior chamber, until its point again pierces the cornea opposite its entrance, and at an equal distance from the sclero-corneal margin. The same movement is to be continued, the blade being kept absolutely parallel with the iris, so as to fill the wound in the cornea, and prevent the aqueous from escaping, until the counter-opening in the cornea has been completed. The knife having been pushed onwards almost up to its heel (see Fig. 52), a small bridge of the cornea will still remain undivided; the surgeon now lets go his hold of the conjunctiva with the toothed forceps, and turning the edge of the knife a little forwards, divides the remainder of the corneal flap as he withdraws the instrument from the eye, so that the last portion of the cornea is cut through by a movement of the knife from within outwards.

Preliminary arrangements.

Making the corneal section.

The flap completed in withdrawing the knife.

The section of the cornea having been completed, we must remove the stop speculum, and allow the lids to close; this finishes the first stage of the operation.

*2nd Stage of the Operation.*—This consists in lacerating the capsule of the lens, which may be done with a curved needle or a cystotome. It may be necessary at this stage of the proceeding to draw the eye slightly downwards with the fixing forceps, if the patient is under an anæsthetic; otherwise, make him look toward his feet: the cystotome is then to be introduced into the anterior chamber, with its convexity downwards, so as to

*2nd Stage.* Lacerating the capsule.

Avoid the iris.

avoid wounding the iris. When opposite the pupil, the handle of the instrument should be rotated, and its point made to tear open the capsule by two or three incisions. The instrument is then to be withdrawn from the eye, and the lids allowed to close.

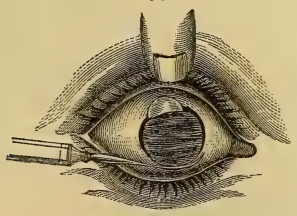
*3rd Stage.* Removing the lens,

*3rd Stage.*—The third stage of the operation consists in removing the lens. The concavity of the curette is to be laid against the lower part of the sclerotic, and slight pressure made

by gently compressing the globe,

with it upon the globe; at the same time the point of the forefinger of the left hand is to be placed on the sclerotic, just above the section; by careful pressure, first with the curette and then with the point of the finger, the upper edge of the lens slowly turns forwards, passes through the pupil, and gradually protrudes through the incision in the cornea (Fig. 53). The pressure is now to be diminished, the lens being completely extruded by the elasticity of the tissues compressing it; and it may be coaxed on if necessary by inserting the curette into the wound, and exerting a slight degree of traction force on the lens, thus helping it onwards and out of the eye.

FIG. 53.



and slight traction.

The lens having been removed, the lids are to be closed, and after a few minutes again opened, and the eye carefully examined;

Remove fragments.

any small particles of lenticular matter which may be seen in the anterior chamber must be removed with the curette. The edges

Close lids.

of the flap are then to be adjusted and the lids closed, a compress and bandage being at once applied over both eyes.

Accidents during flap extraction.

*Accidents during the Operation.*—Before considering the after-treatment to be followed in cases of flap extraction, I may advert to one or two of the most common mishaps that sometimes occur during the operation, and the best means of providing against, or overcoming them.

I think it always very advisable to test the eye so as to see

if the pupil dilates freely under atropine before attempting to operate by a flap extraction. If the pupil does not dilate fully under the influence of atropine, then I strongly recommend that the upper section of the iris should be excised before the lens is removed. If it is determined to administer ether, let the patient be completely under its influence before we commence the operation.

If while the section through the cornea is being made the aqueous escapes, the iris will very probably protrude before the edge of the knife. Under these circumstances, the surgeon should make gentle pressure over the cornea with the point of his finger, so as to force the iris back behind the blade of the knife; but if this manipulation does not succeed, it is better to cut steadily on, and finish the section, excising a fold of iris at the same time. A portion of the iris being thus shaved off, a bridge of this structure is often left between the hole thus made and the pupil; this strip of iris had better be divided before attempting to remove the lens.*

Escape of aqueous.

The iris may be wounded.

If the section in the cornea is too small to allow the easy egress of the lens from the eye, do not try to force the lens through this insufficient opening; any such endeavour will lead to irreparable damage in at least fifty per cent. of the cases in which you attempt it, and in many others it will altogether fail to effect the object in view, the vitreous rather than the lens being squeezed out of the eye. Under these circumstances, supposing the patient not to be under the influence of ether, both he and the surgeon will have to exercise all the patience at their command, the latter endeavouring to enlarge the opening in the cornea by means of a pair of blunt-pointed scissors, the incision being carried downwards, so as to leave an ample opening through which the lens may escape.

Enlarge too small a section.

Very gentle pressure should be made with the curette on the globe of the eye, so that in squeezing out the lens we may not press out a quantity of the vitreous at the same time. If any of the vitreous escapes before the lens, we should at once cease all pressure on the globe of the eye, and a scoop or a sharp hook

Escape of vitreous before the lens.

* Lawrence on "Diseases of the Eye," p. 627.

may be passed through the wound, and the lens gently withdrawn from the eye.

It sometimes happens that on making pressure upon the eye, the lens does not readily present itself in the pupil, in consequence of our not having sufficiently lacerated the capsule, in which case the cystotome must be re-introduced, and the capsule fully torn open. In most of these cases, however, it is an insufficient section in the cornea, and not the capsule of the lens, which is at fault.

Loss of vitreous after.

But supposing that at the moment the lens escapes through the opening in the cornea a gush of vitreous follows, the eyelids must be at once closed, and a compress and bandage applied over both eyes. I do not believe that the loss of a small quantity of vitreous from the eye is a matter of consequence, and even a fourth of the vitreous may be lost, and yet the patient make a very good recovery;* nevertheless, authorities of repute declare that accidents of this kind are to be carefully avoided, for loss of vitreous they think likely to be followed by hyalitis, or by detachment of the retina.

Prolapse of iris.

After the section has been completed, if, on opening the eyelids we find that a portion of the iris is engaged in, or prolapsing through the wound, we should at once endeavour, by means of

Replace if possible.

a gentle rotatory motion of the point of the finger over the closed eyelid, to return the prolapsed iris into the anterior chamber.

Iridectomy.

If this method does not succeed, the best plan we can adopt is to perform iridectomy, removing the superior section of the iris. We may save an eye by this proceeding when all other means of treatment would fail. If, however, the patient has

Prevented by chloroform.

been rendered perfectly insensible with ether, there will be far less chance of a prolapse of the iris taking place than if he is straining, which is almost sure to happen towards the close of the operation if anæsthetics are not employed.

Guard against reflection of the flap.

The extraction having been completed, care must be taken in closing the upper lid, otherwise the corneal flap may be turned backwards. To prevent this, some of the cilia should be taken

* Lawrence on "Diseases of the Eye," p. 627.

hold of, and the upper eyelid gently drawn away from the globe as the lid is being closed; the eye should not be again opened.

*The After-Treatment of Flap Extraction.*—This should be directed in the first place towards keeping the edges of the wound in the cornea in accurate apposition, so that it may unite by the first intention; consequently, during thirty-six hours after this operation, the eye and the patient must be kept absolutely at rest. The former of these objects may be secured by applying a compress and bandage carefully over both eyes, and the second, by keeping the patient in bed, and everything about him as quiet as practicable.

Promote union by rest.

Immediately after the operation, and before the patient rises from the operating table or bed, a piece of soft linen is to be laid over the closed eyelids of both eyes, and two light pads of cotton wool are placed over the linen, and the whole secured in position by means of a gauze bandage, so as to keep the eyes at perfect rest; if all goes on well, the bandage need not be removed for twenty-four hours. I apply the bandage very lightly, and with the sole object of keeping the eye at rest, and the edges of the corneal section in apposition till they have united.

Apply a compress and bandage.

The bandage having been adjusted on the operating-table, the patient must be conveyed to bed, and directed to lie as much as possible on his back for the first few hours after the operation; he may then be allowed to turn on either side, but not to raise his head off the pillow, cough, or use any straining effort, and by no means to disturb the bandages. If the eye is bandaged in this way there is no necessity to keep the patient in a dark room. If there is much pain in the eye towards the evening after the operation has been performed, the compress must be removed for an hour or so; the surgeon should under these circumstances remain with his patient until the pain has subsided. If the pain continues, draw down the lower eyelid and drop some solution of atropine on the everted conjunctiva, and then the elastic bandage without the compress may be reapplied. A dose of morphia also may be given. There will necessarily be some uneasiness in the eye

Morphia if there is pain.

after the operation, but this is to be expected. Pain in the eye is frequently caused by the accumulation of tears under the closed eyelids, and may be removed by gently everting the lower lid twice a day after the first twenty-four hours have passed.

Liquid food.

With regard to diet, the patient may from the day of the operation have chicken soup, milk, or other fluids which can be poured into his mouth with a feeding cup; it is of importance not to allow him to rise from his bed, or chew any hard substance during the first twenty-four hours after the operation.

Usual diet after four days.

Four days having passed from the time of the operation, we may allow our patient more liberty; he may sit up, and begin to take solid food; in fact, if all has gone on well, he may now return to his usual dietary, and in some cases beer or wine may be taken, in others it is necessary to abstain from stimulants until the patient can move about a little. On this subject Mr. Dixon remarks:—"Independently of prolapsus iridis, non-union of the corneal wound results from the same cause which prevents the union of a flesh wound, or of a broken bone—namely, the depression of the patient's nutritive functions below the proper standard of vigour. To keep an old and feeble person upon 'slops' for several days after extraction, for fear inflammation should set in, is surely contrary to common sense, and to all analogy in sound surgical practice."*

Stimulants if required.

State of the lids a guide to that of the eye.

If at the expiration of twenty-four hours we remove the bandage, and find the eyelids of the eye operated on of a natural colour, not swollen, and no purulent discharge escaping from between them, the patient being free from pain, we may be almost sure that all is going on well. The lower eyelid should be gently everted to allow the tears to escape; the pad and bandage must be again applied. Any unnecessary opening of the lids in order to ascertain the amount of vision the patient possesses is most injudicious.

The compress must be worn for the first four days after the operation, and then a bandage without a compress may be employed for three days more, and subsequently, if all is well, a shade may be substituted for the bandage. The patient must

* Dixon on "Diseases of the Eye," p. 325.

be kept in his room for some fourteen days, after which he can generally bear the light, and may be allowed to use his eye. A month having expired, we may order our patient suitable convex glasses, without which, I need hardly say, he will not obtain the full advantages which the removal of the opaque lens is capable of affording. May be used in a fortnight.

*Accidents following the Operation.*—If some thirty-six hours after the operation, the patient complains of considerable pain in the eye, without any apparent cause, we must remove the bandage, and may either give a full dose of morphia, or inject a solution of morphia beneath the skin of the temple. A cold compress over the eye may be useful in these cases, provided the patient is not subject to rheumatism or gout, in which case warm poppy-head fomentations may be found soothing, and a light bandage should afterwards be applied over the eye. A dose of castor-oil is sometimes beneficial in these circumstances. Accidents after the operation. Pain. Remedies.

Supposing the patient, within two days of the operation, suffers from considerable pain in the eye, and on opening the bandage we find the lids puffy and swollen, with a muco-purulent discharge oozing from between them, we shall have good reason to fear that suppuration of the cornea has set in, and we should at once examine the eye. If diffuse keratitis has begun, the conjunctiva will be found chemosed, the corneal flap may appear swollen and opaque, the edges of the wound infiltrated with pus, and the whole cornea hazy, if not opaque : this state of things is utterly hopeless. Diffuse suppurative keratitis, a hopeless condition.

It may be, however, that the suppurative action is limited to the part of the cornea included in the flap, in which case we may still hope to save the lower part. A strong solution of atropine should be applied to the eye every second hour ; hot compresses must be employed for two or three hours night and morning, and in the meantime steady pressure must be made upon the eye by means of the compress and bandage. Full doses of morphia should be given, so as to relieve the pain and irritation from which the patient suffers, and in robust and healthy patients two leeches may with great advantage be applied to the temple over the affected eye for three consecutive Partial keratitis. *Treatment.* Atropine. Compresses. Morphia.

days ; in weakly subjects large and repeated doses of the tinctura ferri muriatis and chlorate of potash are sometimes useful ; and last, but not least, we may have to administer port wine and beef-tea ; but do what we will, we shall seldom succeed in saving an eye under these circumstances.

Stimulants.

Among the lower classes we not unfrequently find subacute suppurative keratitis commencing in hyperaction in the iris, following flap extraction. Within thirty-six hours of the operation, on opening the bandage, we notice some muco-purulent discharge oozing from between the lids ; the patient probably complains of little or no pain in the eye, and the eyelids are not swollen, but on everting them the conjunctiva is found to be œdematous, and the cornea hazy, the pupil filled perhaps with yellowish lymph, and the upper section of the iris presenting spots of a similar kind on its surface ; the edges of the wound are gaping open, and not the slightest sign of action or an attempt at reparation is apparent in the parts. Under these circumstances, we must endeavour by means of hot bandages, a firm compress, stimulants and nourishment, to excite Nature to a reparative effort ; but do what we will she is generally incapable of responding to our call, and destruction of the cornea follows.

Subacute suppurative keratitis.

Employ warmth and stimulants.

Another danger which we have to fear after extraction is that a prolapse of the iris may occur. This accident may take place at any time within eight days from the operation, as the wound in the cornea will not have thoroughly healed until the first week is over, and of course, till then, the iris may at any moment be protruded through the section ; a slight straining effort, such as a cough or sneezing, may be quite sufficient to produce this result.

Prolapse of the iris.

During first week.

*Symptoms.* A prolapse having taken place, the patient will experience increased irritation and pain in the eye ; the lids become slightly swollen, and a muco-purulent discharge is observed on the compress, or at the inner corner of the eye. On opening the lids, the cornea appears bright and clear, but the lips of the wound are more or less gaping, and a portion of the iris may be seen protruding from between them.

Under these circumstances, the prolapsed portion of the iris

should be touched with a pencil of caustic, and a firm compress and bandage applied over the closed eyelids, and kept there for twelve hours; the bandage may then be removed, and the lids bathed with a little tepid water, but not opened. Some cold cream having been smeared over them, the compress and bandage should be reapplied. This treatment may be continued for a month, the nitrate of silver being employed from time to time. But if after this period the prolapse is as prominent as before, it will be advisable to incise it with a broad needle; the aqueous behind escapes, and the prolapse contracts; the compress and bandage must then be reapplied. This operation may have to be repeated every other day or so, until the prolapse has disappeared.

Apply arg. nit. and compress.

Incise the prolapse,

If this treatment does not succeed, the prolapse may subsequently be snipped off with a pair of curved scissors.

or remove it.

If on opening the eyelids soon after the operation we find a large and widely distended section with a considerable portion of the iris protruding through it, we must at once excise the prolapse with a pair of scissors, and then, closing the lid, carefully bandage up the eye. Considering the steps taken in flap extraction, it is evident, especially in large hard senile cataracts, that the iris must be more or less pressed upon and bruised, as the lens is forced through the pupil and out of the section in the cornea; consequently, we might expect to meet with cases of iritis after this proceeding, and such is in fact one of the complications we have to contend with. Cases of apparent sloughing of the cornea not unfrequently commence in inflammation of the iris after flap extraction: but by far the most common cause of iritis is occasioned by fragments of the capsule and cortical matter of the lens being torn off, and attaching themselves to the iris they set up considerable irritation and inflammation of the part. Moreover, no one can have watched disease involving the posterior layer of the cornea without observing its liability to spread to the iris; and the epithelium of the posterior elastic lamina is often scraped off in the passage of the lens from the eye.

Iritis following extraction;

Iritis may come on within the first six days after an extraction; it may commence by symptoms of violent and rapidly

About the sixth day.

destructive inflammation in the part, involving also the cornea; on the other hand, everything may seem to have been going on well until about the fifth day; the patient then begins to complain of pain in the eye, and on examining it we may discover all the symptoms and appearances of iritis: it is unnecessary for me to recapitulate these here, as they are fully described in the section treating of iritis.

*Treatment.* With regard to treatment, we should apply two leeches to the temple over the affected eye for three consecutive days, but

Atropine. atropine will be our mainstay, and must be freely employed. But if small particles of lenticular matter are seen attached to the iris, or lodged between it and the cornea, and if the pupil will not dilate under the influence of atropine, it is well to give the patient chloroform, and making an opening in the cornea,

Remove lenticular matter. to remove all the lenticular matter we can see with a scoop. If we are in any doubt as to there being lenticular matter behind the iris, which we cannot remove, we hesitate to perform an

Iridectomy; iridectomy; excision of the iris is, however, sometimes followed by favourable results under these circumstances. The question arises as to the advisability of attempting to reduce the iritis, and subsequently performing an iridectomy if the pupil is closed.

when to be resorted to. I think, if on examining the patient's eye on the third day, we find the cornea hazy, pupil dull, but not closed with lymph, the iris refusing to dilate under atropine, and the patient in great pain, we had better wait and endeavour to subdue the iritis; when all symptoms of inflammation have passed away incise the closed pupil; but the operation had better not be performed until hyperaction has ceased in the iris and parts around it.

Rupture of retinal vessels; The most dangerous complication that can occur after extraction of the lens is the rupture of some of the bloodvessels of the retina or choroid. The operation has, perhaps, been an easy one, but within a few minutes after the removal of the lens the patient complains of great pain in the eye, and to our dismay, on opening the lids, we find the anterior chamber not only full of blood, but blood oozing out through the wound in the cornea.

hopeless case. A case of this kind is utterly hopeless: we can do no more

than apply ice over the eye, so as to check the bleeding, but as an organ of vision the eye is completely destroyed. This accident may occur some hours after the operation, if the patient sneezes or coughs violently.

MODIFICATIONS OF FLAP EXTRACTION.—I may now proceed to consider some of the principal modifications of the flap operation which have been advocated within the last few years. Modifications of Flap Extraction.

*Preliminary Iridectomy in Extraction.*—It has been proposed to excise a portion of the iris some weeks before the extraction. In the first instance, iridectomy is to be practised on the upper section of the iris, and after six weeks or two months the lens is to be removed as usual by means of the flap operation. Against this proceeding it is advanced that few patients will consent to undergo two operations of this kind if it is possible to do all that is necessary at one sitting. Iridectomy; some weeks before extraction. Objections.

Iridectomy has been practised immediately after the extraction of the lens with success by Professor Jacobson; he removes the lens in the first instance through a flap formed from the lower part of the cornea, and he then excises a fourth of the corresponding section of the iris. Iridectomy after extraction.

Lastly, an iridectomy may with the greatest advantage be made immediately before the removal of the lens; the section being an upper one, the superior fourth of the iris is excised, and the lens removed as usual. In subjects whose pupils do not dilate under the influence of atropine, and particularly if adhesions exist between the iris and capsule, an iridectomy made at the time of the operation greatly lessens the dangers to which such an eye is exposed from flap extraction. Immediately before removal.

*The Removal of the Lens in its Capsule.*—This is by no means a new method of extracting the lens, having been practised with varying success since 1773, and strongly advocated by Dr. Pagenstecher and M. Sperino; having performed this operation constantly since 1864, I am convinced that, if it were possible in every case upon which we operate to remove the lens in its capsule, without damaging the other structures of the eye, we should have reached perfection in the extraction of cataracts. Removal of lens in its capsule.

Prevents capsular cataract and iritis.

The object we have in view in the operation now under consideration is to remove the lens without opening its capsule. The advantages it offers are, that no capsular cataract can possibly form, and there is no chance of any soft lenticular matter being left clinging to the iris, and setting up irritation and inflammation in that delicate structure : and the greater my experience in these matters, the more convinced I am that most of our failures in extraction are due to the fact of soft lenticular matter and capsule being left in the eye after the removal of the lens.

The usual operation for the removal of the lens in its capsule is performed as follows. This is not, however, the proceeding I adopt, as I shall subsequently explain.

Atropine having been applied so as fully to dilate the pupil, the patient is to be laid on his back. The surgeon, standing by the side of his patient, applies the stop speculum ; and the eye, being fixed with a pair of forceps, an upward linear incision is

The section in sclerotic.

to be made through the *sclerotic*, immediately beyond the margin of the cornea, the same precautions being taken in making the section as I have already described in the case of ordinary flap

Iridectomy.

extraction. A portion of the iris is then to be excised, and

Gentle pressure,

gentle pressure exercised with the curette upon the lower part of the sclerotic, and at the same time counter-pressure is to be made with the point of the fingers upon the upper part of the eyeball. In this way the lens in its capsule may be gently forced out of the eye. If the lens is not readily displaced upon slight pressure being made on the globe of the eye, a shallow round curette may be inserted behind the lens, and a gentle traction

or traction.

exerted on the lens, so as to start it from its position.

The section must be ample.

In making the flap, we must keep slightly external to the margin of the cornea, so as to leave as large an opening as possible, through which the lens may escape, its bulk, when contained within the capsule, being considerable.

Results favourable.

This operation is no doubt a very valuable one, and often leads to most favourable results. Even supposing there is a difficulty in extracting the lens in its capsule, the latter may be opened, and the operation completed as in ordinary flap extraction ; in fact, it will be advisable to resort to this proceeding,

unless the lens and capsule pass through the section in the cornea upon slight pressure being made on the eyeball: any extra force is likely to squeeze out a considerable quantity of the vitreous: and we cannot too strongly insist on the fact, that in extracting a cataract force must never be employed.

The Author's Operation

The operation which I have practised in a large number of cases is a modification of the proceeding I have described in former editions of this work, under the heading of "modified linear extraction." I found that by making an incision through the extreme outer margin of the cornea, and then removing the lens with a scoop, that I seldom lost an eye through suppuration of the cornea—an accident, in spite of all our care, too common among the natives of Lower Bengal, if operated on by means of the ordinary flap extraction. I was always disinclined to perform iridectomy in extraction, upon the principle of not removing from the eye, or any other part of the body, any structure which could be retained without interfering with the result of the operation. And as I have before remarked in former editions of this work, in addition to this objection to excising a part of the iris, it appeared very certain to me, that in cases in which the pupil dilated fully under the influence of atropine, the dangers which the eye ran in extracting the lens was not so much from bruising of the iris as from leaving detached portions of lenticular matter and capsule in the eye; these loose organic substances in the eye, and the unjustifiable endeavours to force a lens through a section in the cornea too small to permit it to glide out of the eye, seemed to me the sources of many of my unsuccessful cases of extraction.

without excision of iris.

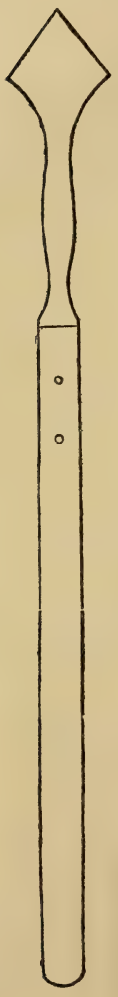
The pupil having been kept widely dilated with atropine for two or three days before the operation, the patient is laid on his back, and placed completely under the influence of an anæsthetic. The operator adjusts a stop speculum.

Directions for making the section.

Supposing the right eye is to be operated upon, the surgeon standing behind his patient with a pair of fixing forceps, seizes a fold of the conjunctiva together with the tendon of the internal rectus, so as to have a steady, firm hold of the eyeball, and in the other hand takes a short and broad-bladed triangular knife (Fig. 54), and thrusts its point through the line of junction of the

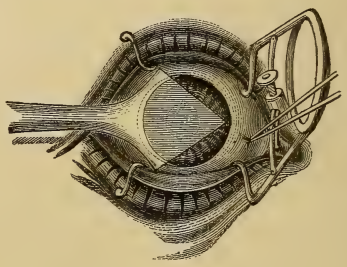
Form of the knife.

Fig. 54.



cornea and sclerotic, on the temporal side of the eye. The blade of the knife is to be passed steadily onwards nearly up to its heel (Fig. 55), so that the incision made through the sclerotic is at least half an inch long. The point of the lance-shaped knife, entering the eye at the junction of the cornea and sclerotic, it is evident that as the blade of the instrument is thrust into the

Fig. 55.



anterior chamber, parallel to and in front of the iris, that the extremities of the incision will extend into the sclero-corneal junction, as shown in Fig. 55.

The knife is to be withdrawn slowly from the eye, so as to prevent the sudden escape of the aqueous humour, which may cause the pupil to contract. An iridectomy is not to be performed unless in exceptional cases to which I shall refer.

**Extraction of the lens.**

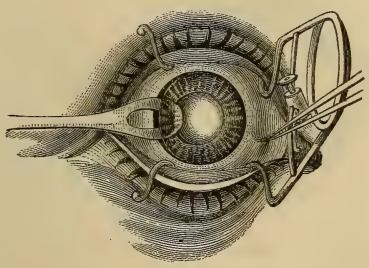
The speculum and hold of the internal rectus being retained, the scoop (Fig. 56) is to be inserted so far into the anterior chamber as to enable us to reach the margin of the pupil; the handle of the instrument being raised, and its rounded extremity depressed, the latter evidently rests on the capsule of the lens, immediately within the margin of the pupil.

**Manipulation with the scoop.**

The scoop is now to be slightly withdrawn, still keeping its extremity on the lens, but so as to draw open

the pupil far enough to enable us to exercise gentle pressure upon the circumference of the lens; it frequently happens that the lens is thus rotated on its axis, and comes to rest in the concavity of the scoop, and so may be withdrawn from the eye. In other cases, if the lens does not readily shift its position into the instrument, we must pass the scoop on behind it (Fig. 57), until its bent and toothed extremity embraces the inner margin of the lens; in this way the lens comes to lie in the concavity of the scoop, and may be removed from

FIG. 57.



the eye (Fig. 58), if possible without breaking the capsule. Should the capsule of the lens be ruptured, however, during the above-described manipulation, the bulk of the lens must still be drawn out of the eye by means of the scoop; and subsequently particles of lenticular matter remaining in the anterior chamber should be taken away.

In performing this operation, my aim is to remove the lens in its capsule, particularly if there is much transparent cortical matter round the lens, which would escape detection at the time of the operation, and adhering to the iris, might excite inflammation of that part. Moreover, in cases of senile cataract, the capsule often adheres to the lens with

FIG. 56.

Rupturing the capsule.

The lens may be removed in its capsule.

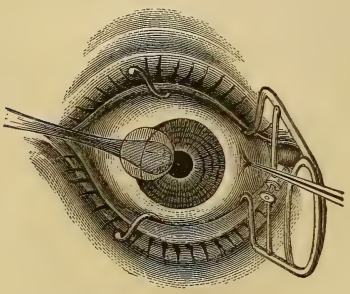
considerable tenacity, and may therefore the more readily be removed with the lens.

After the lens has been taken away, I adjust a compress and bandage over both eyes, and the patient is removed to bed.

Atropine to follow the operation.

Thirty-six hours after the operation, if there is pain in the eye, I usually evert the lower lid, and drop a solution of atropine into the eye. If the pupil expands under the influence of the mydriatic, we need have no further apprehension as to the result of the case; but if the iris refuses to respond to atropine, we

FIG. 58.



have to fear that iritis may supervene. I have been in the habit of performing the operation above described in instances of senile cataract, in which the pupil dilated very slowly, and never very fully under atropine, with, however, this important addition: after having made my incision into the eye, I excise a fourth of the external section of the iris, and then passing the scoop behind the lens, ease it out of the eye without dividing the capsule.

After-treatment as in flap extraction.

*The After-treatment* is to be carried out upon precisely the same principles as those I have indicated in instances of flap extraction; but these rules may be less rigorously enforced. The greater the care immediately after the operation the less chance of subsequent vil.

With regard to the complications that may occur after this operation, I would refer the reader to the observations already made under the head of flap extraction; they are to be treated

in precisely the same way, and I need not therefore reiterate the remarks I have already made on the subject.

LINEAR EXTRACTION.—The operation of linear extraction has undergone various modifications, and is now hardly to be recognized under its old name; it is, in fact, generally described as the Traction operation. LINEAR EXTRACTION.

*Gibson's Operation.*—Linear extraction, as described by Mr. Gibson, is a proceeding which is seldom resorted to at present. It consists in dilating the pupil and lacerating the capsule with a needle, as if operating for solution—only the capsule must be more freely incised. The aqueous, in consequence, gains access to the lens, and renders its already degenerated fibres still softer. Some four or five days after the needle operation, an incision is to be made through the cornea, so as to allow of the introduction of a curette into the anterior chamber; the instrument being now turned edgeways, so as to open the wound in the cornea, the soft lenticular matter escapes, together with the aqueous, from the eye. It will be evident that this operation can only be employed in instances of soft cataract; and even then it is attended with considerable danger, in consequence of the irritation that may be set up from the pressure exerted by the swollen lens in the eye, or from small pieces of cortical matter which may be left attached to the iris. Gibson's operation. Inapplicable to soft cataract.

*The Linear or Traction Operation*, as described by Messrs. Bowman and Critchett, is performed as follows:* The patient having been laid on his back, and the stop speculum introduced, the surgeon fixes the eyeball with one hand by means of a pair of toothed forceps, and taking an iridectomy knife in the other, makes an opening through the corneo-sclerotic junction at its upper part. The traction operation. The section.

The opening must occupy about a fourth of the circumference of the cornea, so as to allow the introduction of the scoop into the eye. In the case of a soft cataract, there will be no necessity to make quite so large an opening as this.

The incision having been completed, a fold of iris is to be Iridectomy.

* *Ophthalmic Hospital Reports*, vol. iv. p. 315.

Management of hæmorrhage.

excised, as in iridectomy. Should there be any bleeding into the anterior chamber, the curette must be introduced between the lips of the incision and slightly pressed upon the sclerotic edge of the wound, At the same time, the tendon of the inferior rectus must be seized with a pair of forceps, and the eye gently pulled downwards, so as to cause just sufficient pressure to squeeze the blood out of the anterior chamber.

The capsule to be freely torn.

The capsule of the lens is then to be lacerated freely—if possible, as far as the suspensory ligament; but that structure should not be broken through, if it is possible to avoid doing so. If much transparent cortical substance surrounds the opaque part of the lens, Mr. Bowman inserts the point of the pricker into the lens substance, and then slightly rotates the body of the lens on its antero-posterior axis, so as to loosen it from the capsule. If this is not done, the cataract is very apt to adhere to the capsule.

The lens removed with a scoop.

The lens is then to be removed with a scoop or traction instrument, which is to be introduced through the wound in the cornea, and passed gently onwards between the capsule and the nucleus of the lens. The lens having been secured by the scoop, the instrument is to be withdrawn from the eye, and with it the lens. Any small portions of lenticular matter, which may be left behind in the anterior chamber, are to be carefully removed with the scoop or the suction instrument, and the eye is then to be closed, and a compress and bandage applied over it.

V. Graefe's Modification.

Von Graefe's Modified Linear Extraction.*—The patient having been placed under the influence of chloroform, the lids separated by an adjustable speculum, and the eyeball drawn downwards by forceps applied immediately *below the cornea*, the operation is commenced.

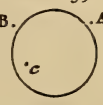
1. Directions for making the section.

*Step I. The Incision.*—The point of a long narrow-bladed knife, with the cutting edge directed upwards, is inserted in the sclerotic, near the upper and outer portion of the cornea, at the point A (Fig. 59), so as to enter the anterior chamber as peripherally as possible. In order to widen the extent of the

* *Ophthalmic Review*, vol. iii. p. 25.

inner wound, the point should at first be directed downwards and inwards towards C, and then, when the blade has advanced about $3\frac{1}{2}$ lines into the anterior chamber, the point of the knife is to be directed up and along to B, where the counter puncture is to be made; great care must be taken that this point does not lie too far back in the sclerotic. Only when the knife has advanced fully $3\frac{1}{2}$ lines within the visible portion of the anterior chamber should the handle be lowered, and the instrument directed along the scleral border on to B. As soon as the resistance to the point is felt to be overcome, showing the counter puncture to be accomplished, whether the uplifted conjunctiva be transfixed or not, the knife must immediately be turned steeply forwards, the back of it being almost directed to the centre of the ideal sphere of the cornea, when the incision is to be continued in this plane: first, by boldly pushing the knife onwards, and then, after its length is exhausted, drawing it backwards. Should this latter movement, though generally sufficient, fail completely to divide the scleral border, the sawing manœuvre must to a less extent be repeated. As soon as the last bridge of the scleral border is cut through, the knife lies freely movable under the uplifted conjunctiva, which, in order to avoid the formation of too long a flap (the proper height is $1\frac{1}{2}'''$—$2'''$), must now be divided by a sawing movement horizontally forwards, or even forwards and downwards.

FIG. 59.




*Step II. The Iridectomy.*—The holding forceps having been handed to an assistant, with a straight pair of iridectomy forceps we lift the conjunctival flap of the prolapsed iris, and reflect it down over the cornea, when the prolapsed portion of iris appears perfectly bare. Hereupon, the prolapse of the iris is seized with the forceps at its central and most vaulted portion. It is gently pulled upon, so as to make it present a triangular shape, and excised at its base from one corner of the wound to the other, to which end usually two slight strokes of the scissors are required, care being taken that little tags of iris are not left involved in the angles of the wound. After excising the iris, we should direct our attention to the position of the

2. The Iridectomy.

sphincter papillæ, and if we find that its angles are curled upwards, or involved in the section, we should press them gently back with the curette, so that the sphincter comes to be in its normal position flat upon the capsule of the lens. If, at this stage of the operation, hæmorrhage takes place into the anterior chamber, the blood may be evacuated by pressing on the cornea with a soft sponge; in some instances it may be necessary to lift up the corneal flap, and squeeze the blood out of the anterior chamber by rubbing the lower lid on the cornea.

3. Laceration of the capsule.

*Step III. Laceration of the Capsule.*—The operator having resumed the fixing forceps, now with a cystotome properly bent, and which is armed with a fleam, divides the capsule freely by two or three successive rents, beginning from the lower edge of the pupil, and ascending successively along its nasal and temporal margins near to the upper equator of the lens.

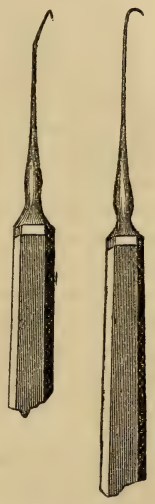
4. Evacuation of the lens. By simple pressure, if cortex is soft.

*Step IV. Evacuation of the Lens.*—The mode of evacuating the lens varies, according to the amount of soft surface matter. Where there is plenty of it, the delivery is, as a rule, effected without the introduction of any instrument, merely by external pressure. The back of a broad and moderately arched spoon is, close to the centre of the incision, gently pressed against the sclera, so that the wound is made to gape. Thus, cortical masses are caused to escape, and the vertex of the nucleus presents itself. In order to promote as much as possible the thorough exit of the latter, the back of the spoon is made to glide along the sclera; first, with an equable degree of pressure laterally towards the corners of the wound, and thereupon, withdrawing it from the wound, upwards with a continuous increase of pressure. If during these movements the diameter of the nucleus presents itself, the pressure is more and more abated, and the delivery may be completed by applying the end of the spoon to the projecting edge of the nucleus. If there be but a thin stratum of soft cortex, the recommended "slide manœuvre" may likewise be tried, but ought to be abandoned as soon as we observe that during the lateral movements no presentation ensues. In this event, the hook must be resorted to, which in the case of hard cataract is required *ab initio*. The blunt hook which Von Graefe was in the habit of employing

By the use of a hook in harder forms.

has the form represented in Fig. 60, and has its stem bent in such a manner as to enable it to be readily pushed under the nucleus. It is first laid flat on the opening made in the capsule : thereupon drawn back over the near edge of the nucleus, when, by a suitable elevation of the handle, it is brought in the direction of the posterior cortex, along which it is then pushed forward on the flat, until it has passed the posterior pole of the nucleus. The instrument is now between the fingers rotated around its axis, so that the plane of the curved extremity of the hook exchanges its horizontal for the vertical position; or should resistance be felt, an oblique one; and the nucleus, or, as the case may be, the whole lens, is by a gentle traction carried towards the incision.

FIG. 60. FIG. 61.



Von Graefe more recently strongly advocated the removal of the lens by pressure on the lower portion of the cornea with a vulcanite curette. The eye being fixed by means of a pair of forceps holding a fold of conjunctiva below, and to the inner or outer side of the cornea, the curette is placed along the lower margin of the cornea, and pressure made backwards and upwards, as in ordinary flap extraction, the same precautions being taken as I have already described when considering the older operation.

Modification.

*Step V. Clearing of the Pupil, and Coaptation of the Wound.*—Von Graefe adds, if, as happens in the majority of cases, after extraction of the nucleus, cortical masses remain, they must be evacuated by gentle pressure and friction, exercised with the finger-ends through the medium of the lids, and in accordance with the well-known rules for the same purpose observed in flap extraction. Only in exceptional cases may a small spoon be introduced for the removal of isolated cortical fragments, which may be partially adherent to the capsule. Very delicate coatings of the capsule, if their evacuation be difficult, are better left behind; but, on the whole, as complete a removal as possible of the cortex should be insisted on.

5. Removing cortical fragments.

Closing the wound.

Finally, the wound is to be cleared with forceps from any adherent iris, pigment, or coagula, and the conjunctival flap replaced in its proper position.

After-treatment.

Regarding the *After-treatment* and complications, I would refer to the remarks already made with reference to flap extraction (p. 419).

Liebreich's Operation for Cataract.

LIEBREICH'S OPERATION FOR CATARACT.—The following is Mr. Liebreich's description of his operation :—

The incision of the cornea is to be made with the smallest possible Graefe's knife in the following manner.

Puncture and contra-puncture are made in the sclerotic about one millimetre beyond the cornea, the whole remaining incision passing with a very slight curve through the cornea, so that the centre of it is about one millimetre and a half distant from the margin of the cornea. This incision can be made upwards or downwards, with or without iridectomy, and the lens can be removed through it with or without the capsule.

"If, as I now practise, the extraction is made downwards without iridectomy, the whole operation is reduced to the greatest simplicity, and does not require narcosis, assistance, elevator, or fixation; and only two instruments—namely, Graefe's knife, and one cystotome, with Daviel's spoon."*

Taylor's Operation for Cataract.

TAYLOR'S OPERATION FOR CATARACT.—The special object of this operation is to extract the lens through a peripheral section of the iris without injuring the pupil.

The following is Mr. C. Bell Taylor's account of his operation :—

The instruments I employ are a pair of sharp forceps that pierce the sclerotic; a very light speculum (a modification of Von Graefe's); and two knives, a line in width, and bent at an angle similar to the ordinary iridectomy knife—one with a sharp point, the other with a blunt or bulbous extremity.

Having separated the lids with the speculum, the eye should be gently turned downwards with a pair of ordinary forceps in

* *British Medical Journal*, Dec. 2, 1871.

the operator's right hand. Having got the globe into a favourable position, it should be fixed by the sharp forceps at about the junction of the upper with the middle third of the cornea; the pointed knife is then entered in the corneo-sclerotic junction 1 or 2 lines from the forceps at the summit of the cornea, pushed well into the anterior chamber, and then, with a gentle sawing motion, carried along the summit until about one-third of the cornea has been incised. The capsule is then carefully divided with Von Graefe's cystotome, having been previously rendered tense, and the eyeball fixed with a pair of ordinary forceps. It is better to open the capsule at this stage, because bleeding from the wounded iris — and conjunctiva also—at a later period is apt to fill the chamber and render this part of the operation obscure and difficult. The upper segment of the iris is then seized, and a small piece of the periphery only excised, the pupillary margin and portion of iris attached to it being left untouched and free in the anterior chamber; the lens is then extruded through the gap in the ordinary way, gliding behind the pupil, so that there is no stretching of the sphincter.

In this way I believe that I have secured all the advantages, in the way of safety and certainty, of an associated iridectomy (which I have already detailed), and at the same attained that grand desideratum—a central and movable pupil.

SELECTION OF AN OPERATION.—We may now pass on to the consideration of the circumstances which would probably lead us to select either one or other of the operations described for the removal of a cataract. SELECTION OF AN OPERATION.

The operation for solution of cataract is a most valuable one, but the great drawback to it is the length of time it often takes to cure a patient by this means. Solution is applicable to instances of soft cataract occurring in persons under thirty-five years of age, or before the nucleus has fully formed. If in a case of this kind the sight of one eye is almost destroyed by a cataract, and the other eye is beginning to get dim, most surgeons would select the operation of solution as being the one likely to yield the best results, the worst eye, of course, being operated on. Advantages of solution.

Too tedious for the poor.

This rule, however, is more applicable to the case of private patients than to those in hospital, because the latter class can ill afford the time necessary to complete the cure, particularly if they come from a distance, and cannot consequently attend as outdoor patients. Nevertheless, I find from the Moorfields Hospital Reports, that in 1866, of 349 cataract cases operated on, not less than 99 were treated by solution; this is a fair criterion of the high estimation in which the very able surgeons in charge of the Moorfields Hospital hold the operation. I have lately operated on cases of hard senile cataracts far advanced in one eye, the other lens being tolerably transparent; in instances of this kind the operation of solution may with advantage be practised on the cataract, and so before the other eye has got very dim the cataract is gradually absorbed. Contrary to the opinion I formerly held, I find that however hard the nucleus, in the course of time it may become absorbed.

V. Graefe's method in hard cataract;

In arriving at a conclusion whether we shall extract a cataract by the old flap method, or some of the modifications of this proceeding, we must take into consideration the circumstances of the patient. The prevailing opinion among ophthalmic surgeons of the present day is that there is no operation which affords a patient affected with senile cataract a better hope of recovery than Von Graefe's method of removing the lens:* and I most certainly concur in this opinion, provided it is found that the patient's pupil does not fully and quickly dilate under the influence of atropine; but if the pupil does act thoroughly after atropine has been employed, I am of opinion that we should remove the lens in its capsule; at any rate, I am not disposed to excise any portion of the iris if the pupil is well dilated, and cannot thus hinder the passage of the lens from the eye.

and in cortical.

In the mixed or cortical cataract the majority of surgeons would prefer to operate by Von Graefe's proceeding rather than by modified linear extraction; nevertheless, my own success has been so great in instances of this kind by the employment of

* On Extraction of Cataract, by H. Wilson, St. Mark's Hospital, Dublin: *Dublin Quarterly Journal of Medical Science*, May, 1870.

the operation I have described at p. 427, that I cannot but advise giving it a fair trial. In Europe, with the advantage of skilful assistants to help at the time of the operation, and good nurses to attend to the patient afterwards, we might prefer Graefe's operation in cases of cortical cataract, but in India we seldom have these advantages, and have to depend mainly upon ourselves for success. We shall be called upon to operate very often on comparatively young people, say from forty-five to fifty years of age, and in instances of this description I have gained most satisfactory results by means of modified linear extraction, seldom finding it necessary in cases of this kind to excise a portion of the iris.

Or the author's modification.

Mr. H. Cayley, of Calcutta, has written on this subject. He remarks that in one year (excluding cases of soft cataract) he operated on 135 cases of hard or mixed cataract: of these, 38 cases operated on by Graefe's method, "29 were successful, leaving the hospital with good sight. This gives nearly 77 per cent. of cures." "The cases of Macnamara's operation gave the following results. The total number of cases was 97, of which 84, or nearly 87 per cent. were successful; in 3 cases iritis set in, from which the patients recovered with a fair amount of sight; *in* 53 *of the* 97 *operations the lens and capsule came out entire, and only one of these went wrong: this patient was suffering from chronic bronchitis, and a violent fit of coughing caused hæmorrhage into the vitreous chamber.**

Iridectomy, again, may be useful in instances of zonular cataract, provided we find its centre opaque, and the outer part of the lens free from striæ or opaque dots. Under these circumstances we may fairly assume that the opacity in the lens will not advance, or if it make any progress that it will do so very slowly; and it will then be advisable, by means of an iridectomy, to open a passage for the rays of light to the

Zonular Cataract.

Operations for.

* Notes on Operation for Cataract, by Surgeon-Major H. Cayley: *Indian Annals*, July, 1875. These results of Mr. Cayley's are precisely the same as my own when operating for cataract by the removal of the lens in its capsule.

retina through the transparent part of the lens ; it is evidently far better to leave the lens *in situ* if possible. But supposing that, from the presence of striæ and spots, together with increasing impairment of vision, we have evidence of advancing changes in the lens, it is then advisable to open the cornea by means of a linear extraction knife, and so to withdraw the lens from the eye with the help of a scoop.

Extraction of opaque membrane.

In cases where a soft cataract has in part become absorbed, leaving a deposit on the inner surface of the wrinkled capsule, I usually open the cornea, pass a pair of iridectomy forceps into the eye, and seizing the opaque membrane withdraw it at once. The pupil must be kept fully dilated with atropine, and the compress and bandage applied as usual after these operations.

Cataract complicated with synechia.

As I before remarked, we sometimes meet with instances of cataract complicated with synechia. Before attempting any operation in these cases we must endeavour carefully to ascertain what amount of vision the patient possesses, by moving a bright light before his eyes ; if he is unable, even in a dark room, to see the flame of a lamp, it is seldom that we can do good by means of an operation ; for the chances are, that although we remove the opaque lens, the retina will have been so far involved as to prevent our patient's benefiting much by the extraction.

Treatment of.

In operating in instances of cataract complicated with synechia, we should first perform iridectomy, and then remove the lens with a scoop, or Bowman's traction instrument.

Capsular cataract after extraction.

CAPSULAR CATARACT.—One of the varieties of capsular cataract with which we have to deal is that which occurs after the removal of an opaque lens. The patient may have made a good recovery from the operation, but still complains of dimness of vision; the cause of this will probably be detected on dilating the pupil, and examining the eye by the lateral method of illumination, or by means of the ophthalmoscope, when a slight film may be seen extending behind the pupil, occasioned by an opaque layer formed on the inner surface of the capsule, which had not been entirely removed at the time of the operation. The

cells produce neoplasms, which as they grow render the inner surface of the remains of the capsule more or less opaque.

Capsular cataract, again, may occur after cyclitis and inflammatory affections of the deeper structures of the eye. In these instances we shall at once understand the nature of the case, from the presence of complications such as exist after iritis, synechia, loss of brilliancy in the fibrous structure of the iris, immobility of the pupil, and so on. In these cases the epithelium lining the capsule appears to become involved in the hyperplasia, and neoplasms are formed, which, becoming organized, induce capsular cataract, and very probably subsequent degeneration and opacity of the lens substance. Capsular opacities of this kind are often star-shaped, the most central portion looking chalky, and shading off towards the circumference of the lens.

After inflammation.

From changes in the epithelium.

Capsular cataracts may occur from the formation of neoplasms (the result of iritis) on the anterior surface of the lens (capsule). In this case the neoplastic formations are simply deposited on the capsule, and becoming organized, give rise to an opacity, which is generally complicated with extensive synechia, if not with closed pupil. Organized deposits may likewise form on the anterior surface of the capsule in instances of suppurative keratitis, lymph having become organized on the cornea is subsequently deposited on the lens. And, lastly, in instances of purulent conjunctivitis among infants, the cornea may ulcerate, the lens is forced forwards against the ulcer, neoplastic formations form on its capsule, then the ulcer heals, and the lens returning to its normal position retains the opaque formation it received when in contact with the cornea.

From external deposits.

Considerable care is necessary in operating upon capsular cataracts which have formed after the removal of the lens; all irritation should, as a rule, have subsided in the eye before any attempt is made to break down the opaque capsule, and it is hardly likely, therefore, that we shall be able to operate under a period of two months from the date of the extraction.

*Treatment.*

False cataract after extraction.

The most simple plan of destroying these opaque bands is to pass a needle through the cornea, the instrument having a cutting edge, so that we may be able to divide the opaque

capsule with it. The patient having been placed under the influence of ether, and laid on his back, a stop speculum is to be adjusted, and the eyeball fixed, an assistant seizing a fold of the lower part of the conjunctiva with a pair of forceps. The surgeon then passes a needle through the cornea, and behind the capsule, so that it may be made to cut an opening through, or break down, the opaque membrane; there is no necessity for passing the needle deeply into the vitreous; our object is simply to comminute the opaque membrane without dragging on the contiguous parts, either of the capsule or iris.*

Operation with one needle.

It often happens, however, that the opaque membrane or band yields to the needle, so that it is impossible to break it through; under these circumstances a second needle is to be introduced through the cornea, at a point nearly opposite the first one, and the extremity of one being passed behind, and that of the other in front of the opaque band, the needles are made to rotate round one another, so as to tear down the capsule. I think it is better at once in these cases to make an opening sufficiently large in the cornea to allow of the introduction of the blades of De Wecker's forceps scissors into the eye; one blade of this instrument is passed through and behind the iris and exudation mass, the other blade along the posterior surface of the cornea. With one or two incisions a portion of the iris is removed, but in some instances, on making a single cut through the false membrane and iris, the edges of the wound retract to such an extent as to leave a very good opening for the passage of light into the eye.

Use of two needles.

Treated by iridectomy.

In some cases the pupil is completely closed by the remains of the capsule, and neoplastic elements resulting from secondary iritis. The communication between the anterior and posterior chambers being thus cut off, glaucomatous changes are apt to occur in the eye, indicated by supra-orbital pain and increased tension of the globe. In cases of this kind, it is most advisable that a portion of the iris should be excised, and the opaque membrane which adheres to it removed.

Closed pupil.

* Bowman on Capsular Obstructions: *Ophthalmic Reports*, vol. iv. p. 364.

After-treatment

The after-treatment in these cases of capsular cataract consists in keeping the pupil as fully dilated as possible, and the eye at rest by means of a light pad and bandage; it is also advisable to confine the patient to a dark room until all signs of irritation have passed away from the eye.

TRAUMATIC CATARACT.

TRAUMATIC CATARACT, whether arising from an accident, or following an operation involving the lens, will generally vary according to the size of the opening made in the capsule.

A small wound may leave few traces.

If only a small opening is made in the capsule of the lens, a portion of its cortical substance may prolapse through the wound, undergo fatty degeneration, and become absorbed; the edges of the wound in the capsule then fall together and unite, and a small cicatrix alone remains to mark the site of the original injury.

If larger, some opacity.

If the opening is more extensive, the aqueous finds its way between the capsule and the cortical substance, and produces opacity of the latter. Unless the lens is injured the opacity may be superficial; neoplasms form round the edges of the wound in the capsule, which may close, and the epithelial cells remaining intact, much of the original transparency of the lens returns.

In severe wounds,

Lastly, if the capsule be extensively lacerated, and the aqueous has free access to the lens, degenerative changes make rapid progress in the lenticular matter, which is soon rendered opaque throughout its whole extent. During these changes the lens becomes swollen, and by the pressure it exerts on the iris, may set up considerable irritation in the part, very probably leading to cyclitis, and by sympathetic action too often involving the other eye. In other cases, the pressure of the swollen lens on the parts around induces much congestion of the choroid, and may lead to glaucomatous changes in the eye. The risk of complications of this kind is much increased if any portion of the lens falls forward into the anterior chamber; for by coming in contact with the anterior surface of the iris it greatly increases the irritation going on in the eye.

Lens swollen and opaque.

Sets up inflammation.

Traumatic cataract from a blow.

It by no means always happens that traumatic cataracts are the result of incised wounds of the capsule; sometimes the

capsule is ruptured from a blow on the eye, usually near some part of its circumference, and the aqueous, finding its way into the lens, produces a traumatic cataract.

Diagnosis easy.

A mistake can hardly be made in diagnosing traumatic cataract : the patient's sight has probably been perfect up to the time of receiving a blow or injury on the eye, and on examining it we find that the lens is opaque. It is impossible, however, to predict the nature and extent of the complications which may occur in the choroid or retina, especially in instances of traumatic cataract following blows.

Foreign bodies in the lens.

Foreign bodies in some few instances have been known to pass into the substance of the lens, and without exciting any very great irritation, have induced partial fatty degeneration and softening of the lenticular matter, and then fallen forwards into the anterior chamber. In cases of this kind it may not be possible to see the foreign body in the first instance, on account of the opacity of the lens-substance around it. But instances of this description are very rare : far more commonly a foreign body in the lens gives rise to a traumatic cataract, and usually to intense inflammation of the iris and deeper structures of the eye, which, unless relieved, may terminate in abscess of the globe, and very probably in sympathetic cyclitis in the sound eye.

*Treatment.*

*Treatment.*—If but a small opening has been made through the capsule, it will only be necessary to dilate the pupil, and keep the eye at rest with a pad and bandage ; the parts may recover themselves in the course of time, a minute cicatrix alone remaining to indicate the seat of injury in the capsule.

Atropine and rest.

If the damage done to the eye has been more severe, for the first few days perhaps after the accident, the anterior chamber will be found full of blood ; and when this has become absorbed the lens will be found opaque ; but, as I have before remarked, we shall then be unable to ascertain the nature of any complications which may have occurred behind the opaque lens. In these cases atropine must be applied to the eye, and the parts kept perfectly at rest for a few days.

In case of inflammation remove the lens.

If inflammatory symptoms set in, or have occurred before we see the patient, it is well to administer chloroform, and perform an iridectomy, at the same time removing the opaque lens.

Provided the cornea has not been lacerated, nor a prolapse of the iris taken place, complicating the case, we may operate most advantageously through the upper section of the cornea, removing the superior one-fourth of the iris. But if a prolapse of the iris exists, and the injury is a recent one, the protrusion not having become fixed to the edges of the lacerated cornea, it is well to excise a portion of the iris, including the prolapse. For instance, suppose that a wound has been made through the outer part of the cornea, and the iris drawn into it, and that the capsule having been ruptured, a traumatic cataract exists with symptoms of cyclitis, I should, if the case were a recent one (having put the patient under the influence of chloroform) open the sclerotic, and remove the outer fourth of the iris. Eserine should be freely applied to the conjunctiva after an operation of this kind.

If iris prolapse, excise it.

Palliative measures, such as rest, leeches, atropine, soothing applications, and so on, are recommended by some surgeons in these cases, before resorting to the treatment above indicated; but I have seen so much harm result from waiting, and such admirable results ensue from the operative treatment, that I can safely recommend the latter plan, and invariably practise it myself.

Palliative treatment useless.

It may happen after an injury to the eye, particularly among patients suffering from excessive myopia, dependent upon posterior staphyloma, that detachment of the choroid occurs, and that in consequence opacity of the lens gradually supervenes; but in cases of this description we shall have none of the urgent symptoms of cyclitis present, which mark cases of traumatic cataract where laceration of the capsule has taken place; moreover, the opacity comes on comparatively slowly.

Late opacity from detached choroid.

DISLOCATION OF THE LENS.—Dislocation of the lens may be either complete or partial; in the former, the lens is forced out of the eye through a wound in the sclerotic or cornea, but in partial dislocation the crystalline remains attached to some portion of the supensory ligament, and may fall forwards, backwards, or to either side of its normal position in the eye.

DISLOCATION OF THE LENS.

1. *Complete Dislocation of the Lens* is most commonly caused

1. Complete dislocation.

by a sharp blow, such, for instance, as would be given by a raquet-ball, or some such small and hard body. The sclerotic is usually ruptured at its inner and upper part, immediately beyond the margin of the cornea, and the lens escaping through a rent in this situation may be lodged beneath the conjunctiva. An injury causing such a considerable lesion of the eye as this is always complicated with more or less damage to the iris, which is usually torn from its attachment, to a greater or less extent. Immediately after the accident the anterior chamber is filled with blood, and extensive ecchymosis of the skin and conjunctiva occurs.

Rent seen in sclerotic.

Lens beneath conjunctiva.

On examining the eye, the black chasm through the sclerotic will be at once visible, and the lens may generally be recognized by its form and size beneath the conjunctiva. It soon loses its transparency, and then appears as an opaque mass in the situation above indicated. In other cases the form of the lens is lost by compression in its passage through the rent in the sclerotic, and until it becomes opaque we may be unable to distinguish it from vitreous.

Lastly, the lens may be driven completely through the sclerotic and conjunctiva, and fall on to the patient's cheek.

*Treatment.*

Remove the lens. Close the wound.

*Treatment.*—If the dislocated lens is still to be seen beneath the conjunctiva, it is well to slit open the mucous membrane and remove it. Under any circumstances the rent in the sclerotic should be closed, its edges being brought together with one or more fine silk sutures; the eyelids must then be shut, and kept at rest until the irritation excited by the accident has entirely subsided.

2. Partial dislocation.

Lens variously displaced.

2. *Partial Dislocation of the Lens.*—This accident usually occurs from a blow on the eye or forehead, the lens being partially torn from the suspensory ligament, and displaced either upwards, downwards, or to either side; in some cases it is thrown forwards, and rests partially or completely in the anterior chamber. Under these various circumstances, the patient's sight is more or less impaired, for the dislocated lens not only becomes somewhat hazy, but by bobbing about behind the pupil interferes considerably with the perfection of vision.

May not follow the injury.

It does not always happen that the displacement of the lens immediately follows the receipt of an injury; several days may

have elapsed since the accident, when from an effort of coughing or sneezing, the already damaged suspensory ligament is ruptured, and the lens dislocated.

On examining the eye, provided the lens has not been thrust forward into the anterior chamber (the pupil having been dilated with atropine), we shall observe the lens swinging about with every movement of the eye, its structure being slightly opaque, and the black chasm of the vitreous appearing behind that part of its circumference which has been detached from the suspensory ligament. The iris, from the loss of support afforded it by the lens, is tremulous.

Lens seen moving.

Iris tremulous.

If the lens has been dislocated forwards, it may occupy the entire pupil, and remaining almost transparent there may be some little difficulty in detecting the nature of the injury. The light, however, being reflected by its edges, presents a prismatic or glistening circle within the eye, the iris is pressed back, rendering the anterior chamber larger than natural, and the pupil dilated and motionless.

Dislocation forwards:

Appearances.

The following is a case in point :—

W. M., of the E. I. Railway, when a child received a blow on the forehead, after which his eyes became affected. In the left eye there is no lens, and the eye has been in its present state from the time of the accident : the lens has probably been absorbed. The right eye was healthy to within the last month, when he unfortunately received a blow on it, and immediately afterwards his sight became much impaired. On his coming to me, I found the right lens dislocated forwards and distending the pupil ; it was perfectly transparent, and as the man's sight was fairly good I did not consider it necessary to remove the lens.

*Case.*

I saw this patient again two months after the accident : the lens was still in the same position, and quite transparent ; but as it was evidently exciting irritation in the iris and choroid I punctured it with a needle, and it speedily became opaque, and was then removed from the eye by linear extraction.

Under these circumstances, having made a large iridectomy, extract the dislocated lens by means of a scoop. We must be very careful in operating, otherwise the lens will slip from the

Management of displaced lens.

scoop, and fall back into the vitreous chamber. To prevent this accident, it is well first to dilate the pupil as fully as possible, then pass a needle through the cornea, and by means of a gentle drilling motion lacerate the capsule ; some of the soft lenticular matter escapes, and the vitreous thrusts the lens forwards against the cornea, and we may then with safety proceed to the iridectomy and removal of the lens, the scoop passing behind it without difficulty.

## CHAPTER XVI.

*Innervation and Action of Muscles—Diplopia—Direct—Crossed Angles of Squinting—Paralysis—Causes of—Treatment—Shortening of Muscles—Strabismus—Pathology—Convergent—Divergent—Symptoms—Treatment—Nystagmus.*

Preliminary Remarks.

PRELIMINARY CONSIDERATIONS.—It will be advisable, before entering on the subject of this chapter, to make a few preliminary remarks on the innervation and action of the muscles of the eye, and to explain the mechanism of diplopia or double vision, that we may the better appreciate the symptoms complained of by patients suffering from paralysis of one or more of the muscles of the eye.

Distribution of nerves.

INNERVATION AND ACTION OF THE MUSCLES.—The third pair of nerves divides into two branches in the orbit, the upper one supplies the levator palpebræ and superior rectus, and the lower branch sends nerves to the rectus internus, rectus inferior, obliquus inferior, and the sphincter pupillæ.

The fourth nerve supplies the superior oblique.

The sixth nerve the external rectus.

Combined actions of muscles.

1st. The cornea is inverted and everted in the horizontal meridan plane, by the action of the internal and external recti respectively.

2nd. The cornea is directed upwards by the combined action of the superior rectus and the inferior oblique.

3rd. The eye is turned downwards by the combined action of the inferior rectus and superior oblique.

4th. In moving the eye diagonally upwards and inwards, the

rectus superior acts in combination with the rectus internus, being further controlled by the action of the inferior oblique.

5th. In moving the eye upwards and outwards, the rectus superior acts in conjunction with the rectus externus, the inferior oblique limiting the action of the rectus superior.

6th. The eye is turned inwards and downwards by the action of the rectus inferior and rectus internus, the superior oblique also controlling the action of the rectus inferior.

7th. The movement downwards and outwards is accomplished by the rectus inferior associated with the rectus externus, the superior oblique controlling the action of the inferior rectus.

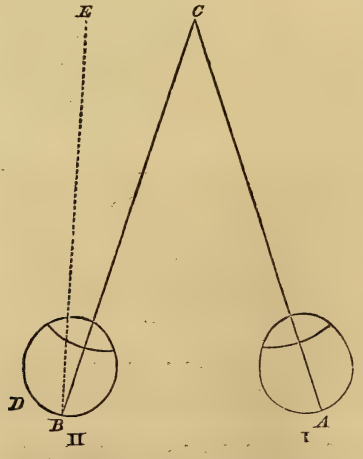
Diplopia.

Harmony of two eyes impaired.

DIPLOPIA.—In order to insure correct vision the eyes must work in unison; for if the rays of light do not fall upon exactly corresponding portions of the two retinæ, double vision or *diplopia* is the result. There are two forms of diplopia, the *direct* and the *crossed;* the former may be understood by referring to Fig. 62. The left eye, B, in this case is supposed to be inverted, the right eye, A, is normal, and directed towards the object C, the rays from which fall on the macula lutea at A; but in consequence of the left eye being inverted, the rays from C will fall on the point B, internal to the macula lutea D, and the image formed will be mentally projected, in a line perpendicular to this spot, in the direction of E; and thus two images of the figure C will be visible, one in its real position, and the other to the left of C at E. The reverse of this would, of course, hold good, if the right eye were

Direct diplopia.

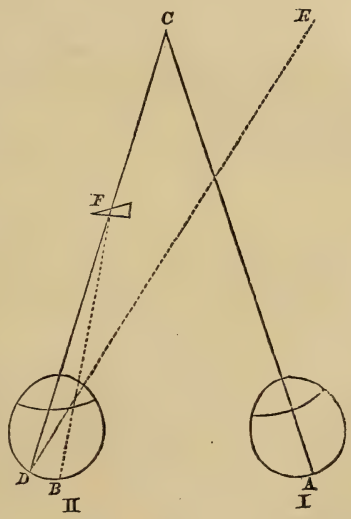
FIG. 62.



inverted; the second image would then be to the right instead of the left of C.

In the second form of diplopia, as its name implies, the images cross one another, as shown in Fig. 63. The left eye, B, is supposed to be everted, and the right eye, A, is in its normal position, the rays of light from the luminous point C falling upon the macula lutea at A; but as B is everted, the rays from C do not impinge upon its macula lutea at B, but on a point external to it at D, and are projected in a line perpendicular to this point in the direction of E, so that they cross those proceeding from C to A, and hence the crossed diplopia. Crossed diplopia.

FIG. 63.




I may here remark, that the course of the rays C D may be changed by means of a prism, as at F, by which they are bent towards the base of the prism, and so fall on the macula lutea at B; in this way the diplopia will be corrected; for although the eye B is everted, the rays from C are directed upon its macula lutea by means of the prism F, and binocular vision is thus restored. Prisms to correct diplopia.

Prisms of this kind are used, not only for rectifying slight diplopia, but also as a test of the presence of binocular vision in cases of *strabismus*. To test binocular vision.

The existence of binocular vision is ascertained in this way. If a prism be held with its base inwards, before either eye, rays passing through it will be defracted towards its base, and falling on the retina, will form an image internal to the macula lutea, which being projected, as in Fig. 62, in the direction E, direct Principle and method of using them.

diplopia will be the result. But the other eye will immediately and unconsciously endeavour to correct this, and by an involuntary motion, it will turn inwards (become inverted), so that the rays of light from the object under observation may fall upon a corresponding portion of its retina, internal to the macula lutea, and thus correct the diplopia. Consequently, if under any circumstances the prism has this effect, we may be sure that binocular vision exists, and the reverse, if no such changes are induced.

The prism test is very useful in cases of assumed blindness, for as Professor Longmore remarks, if a prism of 12° or so be held with its base upwards or downwards before the eye in which visual power is acknowledged to be retained, and the person who is subjected to the test, on being asked what effect it has on his sight, states that it causes double vision, the simulation is proved, for diplopia could only result by both eyes seeing. If the base of the prism is turned inwards, and the other eye turns inwards, evidently an effort is being made to prevent double vision, and the assertion of blindness in the inverted eye is therefore absurd.

Primary and secondary angles of squinting.

PRIMARY AND SECONDARY ANGLES OF SQUINTING.—In the diagnosis of cases of paralysis of the muscles of the eye, as distinguished from strabismus, it is very necessary to notice if the secondary angle of squinting is greater than the primary angle; the former invariably forms the greater angle in all cases of paralysis. By the primary angle of squinting, we mean the angle of deviation of the optic axis of the diseased eye from an object upon which the other eye is fixed. Upon covering the sound eye, the other makes a movement in order to fix its optic axis on the object, causing the covered eye to move in association with it; this deviation of the sound eye is called the secondary angle of squinting, and will be found greater than the primary angle through which the weakened eye has moved.

Illustration.

For instance, suppose the external rectus of the left eye is paralyzed, the patient is therefore unable to evert this eye; but if a candle be held in front of his face, and the right eye closed, on moving the candle to the left of the patient the left eye

makes an effort to follow it, and may be moved perhaps one line outwards; the right eye, we shall find, has made an associated movement inwards of two lines. In this case, therefore, the secondary angle is evidently greater than the primary one. The nervous apparatus of the left external rectus being defective, it requires an increased effort of the will to evert the left eye; but this increase of force cannot be confined to one eye, it is equally propagated to the sound one; and as the healthy muscle responds normally to the increased nerve force, the right eye is inverted considerably more than the left one is everted. As a consequence of the want of action in the external rectus, after a time, secondary changes occur in the antagonistic muscle, leading to alterations in its contractile power, and the diplopia becomes complicated with strabismus, as I shall more fully explain by-and-by.

Why the secondary exceeds the primary angle in paralysis.

## PARALYSIS.

PARALYSIS OF THE EXTERNAL RECTUS.—Let us suppose the left external rectus is affected. On holding a lighted candle, or some such object, at a distance of 5 feet from the patient's face, we find both eyes are fixed on it, and it is only when the candle is moved to the left of the patient that the want of action in the muscle becomes apparent; the optic axes then no longer work in unison, and diplopia is the result. This is particularly noticeable if the candle is held a little below as well as to the left side. On closing the right eye the secondary angle of squinting will be found greater than the primary angle.

PARALYSIS OF EXTERNAL RECTUS.

How detected.

The diplopia which exists in a case of this kind will be readily understood by reference to Fig. 61, for as the object is moved to the left of the patient, the rays of light must fall upon a part of the retina internal to the macula lutea, and being projected forwards the diplopia will be direct. In order to overcome this diplopia the patient is apt habitually to turn his head to the left, and also in striking at an object is likely to hit too far to the left, especially if the right eye is closed and the blow is a rapid one. In the form of paralysis we are now considering, the action of the muscles of the eye, with the exception of the rectus externus, may be perfect.

Nature of the diplopia.

Paralysis of Third Nerve.

PARALYSIS OF THE THIRD NERVE may be complete or partial; in the former case, all the muscles supplied by this nerve are paralyzed, and in the latter, one or more only may be affected.

Supposing complete paralysis of the third nerve of the left eye exists, the first symptom we shall notice will be loss of

Ptosis.

power of the levator palpebræ, the patient being unable to raise his upper eyelid. On opening the lids, we shall find that our

Eye can only move outwards.

patient can only direct the eye outwards; in other directions it is unable to follow an object placed before it, so that if the latter be held above, below, or to the right of the affected eye, diplopia

Diplopia and vertigo.

is produced. In consequence of the illusion thus created in the mind, when the patient attempts to walk across a room to reach an object in front of him, he is apt to stagger much as a drunken man would do.

Exophthalmos.

In some cases exophthalmos results from the loss of power in the recti muscles, and their inability to resist the natural tendency of the elastic contents of the orbit to thrust the eye

Slow pupil.

forwards. The pupil acts very slowly under the stimulus of light, and is more or less dilated.

In instances of complete paralysis of the muscles supplied by the third pair, we have only to bear in mind their combined action in order that we may understand the nature of the diplopia that must occur.

Paralysis of Internal Rectus.

PARALYSIS OF THE INTERNAL RECTUS.—The eye cannot be moved inwards, and a crossed diplopia results if an object is held to the right of the patient (supposing the left eye affected),

Divergent squint.

the squint being divergent. The diplopia is most apparent if the object is held to the right, and above the level of the patient's eye. The secondary angle of squinting is greater than the primary angle, and the patient habitually turns his head towards the right, in order that he may overcome the diplopia as far as possible.

Characters of the diplopia.

The double images are parallel and equally high; except in the diagonal positions to the right and upwards, and to the right and downwards, where there is an obliquity and a difference in height—the image of the left eye, on looking towards the right and upwards, being inclined to the right and lower—

whilst on looking towards the right and downwards, it is inclined obliquely to the left and higher.*

PARALYSIS OF THE RECTUS SUPERIOR (left eye).—The movements of the eye before the horizontal meridian plane are normal; but if an object is moved from below upwards above this level, the patient's left eye cannot follow it. The cornea is seen to be directed forwards and slightly outwards, on account of the action of the inferior oblique muscle being unopposed.

Paralysis of Rectus Superior.

Eye cannot be raised.

Is slightly everted.

If the right eye is covered, and an object is held above the patient's eyes, the paralyzed eye being directed upwards as far as the paralysis will allow, the right cornea is turned upwards and outwards to a greater extent than the left one. The chances are, if the patient strikes quickly at an object, that he will hit too high. In order to correct the diplopia as far as possible, he carries his head directed backwards and upwards.

If the object be held above the horizontal meridian plane of the eye there will be diplopia, and one image appear above the other. The rays of light under these circumstances fall upon the inferior part of the retina of the affected eye below the macula lutea, and the image is therefore projected above that of the other eye; but in consequence of the slight eversion of the cornea which takes place in paralysis of the superior rectus, the images do not appear precisely one above the other, the false image being to the right of the true one as well as above it; in fact, the diplopia is crossed, in consequence of the divergence of the optic axes.

Diplopia on looking up.

False image above and to the right.

PARALYSIS OF THE RECTUS INFERIOR.—The symptoms characteristic of this affection are precisely the reverse of those above enumerated in the instance of paralysis of the superior rectus.

Paralysis of Rectus Inferior.

PARALYSIS OF THE INFERIOR OBLIQUE very rarely, if ever, occurs without some of the other muscles of the eye being involved.

Paralysis of the Inferior Oblique.

* "Principles and Practice of Ophthalmic Medicine and Surgery," by T. W. Jones, F.R.S.; 3rd edit., p. 582.

Paralysis of the Superior Oblique.

Paralysis of the Superior Oblique (left eye).—The patient complains that objects below the horizontal meridian of the eye appear as if double and unsteady; this fault is corrected to some extent by the head being thrown forwards and to the right.

Diplopia on looking down.

On examining the affected eye we find that objects are correctly seen above the horizontal plane, but that below it, in consequence of the cornea being directed upwards and inwards,

False image below and to the left;

while the right eye is directed downwards, the false image will be below and to the outer side of the real one, the deviation of the two figures being greater as the object is placed further beneath the horizontal plane. The secondary angle of squinting is greater than the primary angle. It is a remarkable fact, that in this form of paralysis the false image appears to be

appears nearer.

nearer to the patient than it really is.

I have already considered the circumstances of paralysis of the sphincter pupillæ under the head of mydriasis, and may therefore proceed to make a few remarks on the causes, prognosis, and treatment of the various paralytic affections of the muscles of the eye.

*Causes.*

*The Causes of Paralysis of the Muscles of the Eye* may be divided into two classes. 1st. Those affecting the course of the nerve; and 2nd, disease involving the nervous centre.

1. In the nerves.

1. Among the first of these causes, syphilis holds a prominent place. I need hardly remark that the nerve may be affected

Syphilis.

with neuroma of a syphilitic origin in any part of its course; but fatty degeneration of the nerve as a result of syphilis is probably a more frequent though less palpable source of paralysis of the muscles of the eye. Lastly, syphilitic nodes, or a thickening of the sheath of the nerve, may, by pressing on its true nervous elements, induce paralysis.*

Rheumatism.

Rheumatism, again, appears to be a common source of paralytic affection of the muscles of the eyeball. The attack usually comes on after exposure to cold, and is generally

* Cases of Paralysis of the Oculomotorius, by Professor von Graefe: *Ophthalmic Review*, vol. i. p. 216.

accompanied with violent pain in the head and supra-orbital region.

Malarious influences have evidently a direct relation to the class of diseases we are now considering; hemicrania, apparently depending upon miasmatic influences, being occasionally followed by paralysis of the orbital branch of the third nerve of the corresponding side of the head. Malaria.

Effusions of blood into the orbit, or tumours in this locality, may, by pressure upon the nerve, impair its functions, and cause paralysis of the muscles of the eye. Abscess in the cellular tissue, or disease of the bones of the orbit, may act in the same way. Lastly, Mackenzie has drawn attention to the fact that the third nerve may be injuriously compressed by the posterior artery of the cerebrum, and the superior artery of the cerebellum, should these vessels happen to be much congested, the nerve passing between them as it emerges from the brain. Mechanical compression.

2. Of the second class of causes which produce paralysis of the muscles of the eye—viz., those originating in the nervous centre, we may reasonably expect to meet with symptoms pointing to the seat of the lesion; in not a few cases symptoms of tabes indicate the nature of the case (p. 336). But, as I before remarked when speaking of ptosis, the consideration of these forms of disease would involve us in that most difficult and obscure study—the pathology of the brain, which certainly does not fall within my province. 2. Disease of the brain.

I may, however, observe that the diplopia accompanying paralysis of the third pair, and depending on lesions of the brain, has a marked peculiarity, in that "the double images in these cases show a very great disinclination to be united. Even with the most carefully selected prism it is found difficult or even impossible to unite them; and even if we have effected this, the diplopia generally awakens again as soon as a very slight alteration is made in the strength of the prism or in the position of the object. If we find that several muscles which are supplied by different nerves are paralyzed, together with one or more muscles supplied by the oculomotorius, particularly if both eyes are affected (and we can find no cause within the orbit), we may suspect some cerebral lesion. The same may *Diagnosis.* Diplopia obstinate.

be said with regard to a succession of paralyses in different muscles. If several of the muscles furnished with nerves of the third pair are *successively* affected, and then, perhaps, the trochlearis or abducens also, and after this, one or more muscles of the other eye, we are justified in thinking of a cerebral cause."*

*Prognosis* uncertain in brain cases.

*The Prognosis* in cases of paralysis dependent upon causes situated at the base of the brain, or within the brain itself, must be more or less dubious, but will evidently depend very much upon the nature of the cerebral lesion ; we may hope for amendment in the diplopia if the cerebral symptoms disappear, but hardly otherwise.

Favourable in syphilis or rheumatism.

In cases of paralysis of the nerve depending on syphilitic or rheumatic influences, we may fairly hope that with proper treatment the paralysis will gradually disappear. The same remark applies to instances of paralysis depending on malarious influences.

Must vary with cause of pressure.

The prognosis to be given in cases of affections of the muscles of the eye caused by pressure upon the nerve from effusion of blood, or from morbid growths within the orbit, will evidently very much depend upon the possibility of the removal of the compressing force. If there is no likelihood of this it is hardly possible that the affection of the muscles of the eye will be overcome. On the other hand, effused blood, or even an abscess, may be got rid of, and if so, we may fairly hope for a favourable result as regards the muscular apparatus of the eye.

*Treatment.*

*Treatment.* — In instances of paralytic affections of the muscles of the eye depending upon syphilitic or rheumatic influences, we shall have to enforce a plan of treatment such as I have before recommended in cases of this kind. The tendency of these paralytic affections is to recovery, especially if Nature is judiciously assisted in her efforts to cure.

Tendency to recovery.

In the case of paralysis depending on causes situated within the orbit, should this be an effusion of blood, it is well to allow it to become absorbed ; abscesses should be opened as soon as

Open an abscess.

* Mr. Wells on Paralysis of the Muscles of the Eye: *Ophthalmic Hospital Reports*, p. 29, July, 1860.

possible ; but I would refer to Chapter III., on Diseases of the Orbit, for an account of the treatment to be followed in these affections.

Exercising weak muscle by prisms.

I before remarked that *prisms* are employed in some cases of diplopia with advantage. Supposing the diplopia has to some extent been overcome either by the efforts of Nature or medical treatment, and if no contraction of the opposing muscle has taken place, we may hope by the use of prisms to strengthen the paralyzed muscle, giving it gentle exercise in the following way for some three or four hours every day.

Mode of using them.

I have already explained the action of the prism (Fig. 62) : light being defracted by it towards its base, we may in this way bend the rays of light into such a position that they will fall upon the retina near the macula lutea of the diseased eye. In consequence of the great confusion of vision which is thus caused (the rays of light falling on the yellow spot in the sound eye, and very near it in the weak one), the paralyzed muscle contracts, in order that it may correct the diplopia, by turning the axis of the diseased eye so that the two images may coincide ; and by the daily exercise of this contraction it gradually gains strength, and in time may work without the prism.* Glasses of this kind are useful during the progress of recovery from palsy of the sixth, or partial paralysis of the third nerve, in which the internal rectus is the only muscle, or the one principally affected.

Illustration.

Supposing the external rectus to be paralyzed, the base of the prism should be directed towards the temple, so as to defract the rays of light on a spot internal to the macula lutea ; the external rectus, to correct the diplopia thus caused, would contract and slightly evert the eye, and being gently exercised in this way day by day, would gain strength, and perhaps ultimately recover its former power. In cases of paralysis of the other muscles of the eye, the base of the prism should be placed in such a position as to call the affected muscle into play, upon precisely the same principle as above explained.

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* E. Meyer on Treatment of Strabismus by Prisms: *Brit. and For. Med.-Chir. Rev.*, vol. xxxiv. p. 392.

Electricity.

Faradization is often useful in cases of paralysis of the muscles of the eye, one pole being applied over the closed lid, and the other behind the corresponding ear. The remarks I have already made upon this method of treatment, when discussing the subject of paralysis of the orbicularis and levator palpebræ, are applicable to instances of paralysis of the muscles of the eye.

Tenotomy.

*Operation of Tenotomy.*—We have, according to Von Graefe, another means at our command for overcoming the diplopia produced by paralysis of the muscles of the eye, if the antagonistic muscle is not affected by secondary changes; it consists in the operation of tenotomy, modified according to the circumstances of the case.

Let us again suppose that the external rectus of the left eye is paralyzed, and that other means have failed to cure the disease; we divide the internal rectus, and fix its attachment to the sclerotic further backwards than its normal position. By this means we weaken the action of the internal rectus, so that the external rectus may be able to neutralize it, and thus overcome the diplopia.

Opposing muscle displaced backwards.

Weak one brought forward.

This operation, however, would only answer if the power of the external rectus were but slightly diminished; if much enfeebled, in addition to tenotomy of the internal rectus, we should divide the external rectus, and fix its attachment to the sclerotic close to the cornea. This proceeding may be effected as follows:—The opening in the conjunctiva will have to be rather more extensive than in an ordinary case of tenotomy; it is better, in fact, to expose the tendon of the muscle, and insert a strabismus hook beneath it; a curved needle with a silk thread is passed through the tendon close to its insertion into the sclerotic; the suture is then to be tied. The muscle is subsequently to be cut through about three-fourths of a line from the suture, towards the angle of the eye, and another suture is to be passed through the retracted end of the muscle: the two sutures are to be tied together, and in this way the muscle is shortened. In fact, we have to cut a small piece out of the tendon of the rectus and bring the divided ends of the muscle into

apposition, so that they will unite, and thus shorten the muscle to the extent of the piece we have cut out of it. In this way, by increasing its power over the eyeball, and at the same time diminishing that of the internal rectus, we may possibly correct the diplopia.

One obvious drawback to this operation is that paralyzed muscles commonly undergo fatty degeneration, and it is then of no use endeavouring to force it to increased action by an operation such as I have above indicated. In fact, although in theory it may seem well to perform tenotomy in cases of this kind, my advice is, if the inversion or eversion of an eye depends on paralysis of its muscles, do not attempt any such proceeding.

## STRABISMUS.

Strabismus.

The term strabismus is applied to cases in which a disturbance exists in the relative movements of the eyes, without there necessarily being any actual loss of power in the muscles. Cases of strabismus may be divided into two classes : in the first (strabismus concomitans) the patient never directs the visual axes of both eyes to the same point, they always cross in front of the object, whichever eye is fixed on it. In this case the field of excursion of each eye is not diminished, but only displaced a certain number of degrees inwards or outwards.

Concomitans.

Apparent.

In the second class of cases of strabismus (apparent strabismus), the corneal axes may converge or diverge, while the visual lines cross at the point of fixation. Even in the normal eye the visual lines do not, as a general rule, coincide with the axes of the cornea, but form with them an angle. This angle may be larger or smaller in different individuals, and in consequence the eyes appear to diverge or converge, notwithstanding the perfectly correct action of the visual axes.

*Causes.*

Dr. Giraud-Teulon has supplied us with the following Table, showing the causes, and relative frequency of these causes, in producing strabismus :—

| | Proportion in 100. |
|---|---|
| Congenital preponderance of the group of adductive muscles over those of abduction, very frequently allied with hypermetropia, or the reverse state allied with myopia . . . . . | 60 |
| Spasmodic and paralytic affections of the muscles of the eye, giving rise first to a variable strabismus . . | 15 |
| Ophthalmiæ—opacities of the cornea, results of wounds | 15 |
| Marked amblyopia of one eye, followed often by divergent strabismus of that eye . . . . . | 5 |
| Unknown causes . . . . . | 5 |
| | 100 |

Convergent Strabismus. Pathology. Mr. R. B. Carter's views.

Authorities differ somewhat in their ideas regarding the pathology of strabismus. Mr. R. B. Carter teaches, that in order to obtain clear vision, especially for near objects, hypermetropes are obliged to exercise an inordinate amount of accommodation and convergence, these two functions being intimately connected together through the nervous centres. "The flatness of the eye-ball does not interfere with this intimate nervous connection; and hence the constant action of the muscles of accommodation, in a hypermetropic child, involves an equally constant action of the muscles of convergence, which become abnormally strong, and habitually overpower their antagonists, so that the resting position of the eyes, or their position during sleep, is one of equal convergence instead of approximate parallelism." After a time the child's eyes in looking at near objects start from a position of acquired convergence instead of from a position of near parallelism, the convergence becomes greater than is necessary, and both eyes are directed to a point nearer than the object, and thus double vision is produced. "In order to see clearly, and to avoid the double images, the child renders one eye more divergent, so that it may be directed to the object; and as the two axes have become combined in a relation of convergence, instead of in their original relation of parallelism, it follows that, when one of them turns outwards to fix the object, the other turns inwards in a greater degree than before." It is evident from the excessive convergence which

hypermetropes employ that, in looking at a near object, the images are formed outside the yellow spot in each eye, neither of them being in the highest degree distinct. In consequence of this condition of things, Mr. Carter remarks that the patient is unable "by the action of both external recti to overpower the *stronger* internal recti, and to direct both eyes to the proper point, without at the same time relaxing his accommodation, which he is bound to maintain. But he is able, by the action of one external and the other internal rectus, to turn both eyes together, as if they were actually united.

Dr. Giraud-Teulon. Dr. Giraud-Teulon, on the other hand holds, in concomitant strabismus, that muscular innervation is the same on the two sides; the deviation depending solely upon a disproportion between the length of the muscles.

External Strabismus. Pathology. In consequence of the posterior staphyloma which exists in most cases of myopia, the globe of the eye assumes an ellipsoidal form, and Professor Donders has demonstrated that, in turning round the short axis of a cavity of similar shape, the mobility of the eyes is interfered with. In consequence of this restricted motion inwards, we may assume that the visual lines cannot be brought to intersect at a distance of 2″.5′. In order to bring the visual lines to intersect at this distance the axis of the cornea must be brought under stronger convergence than in emmetropic eyes. Fatigue follows this inordinate action of the internal recti, and the more powerful external muscle rotates the eye outwards.

Myopic patients are, moreover, constantly in the habit of using one eye more than the other; in their endeavours to define small objects they habitually approximate the object to the eye they wish to use; in the meanwhile, the other eye is directed into space, and so the associated action of the internal recti is disturbed. Lastly, the associated action of these muscles is further modified in cases of myopia, in consequence of the refraction of the two eyes frequently differing in a remarkable degree, and so depriving the patient of the advantages of binocular vision, and the co-ordinate use of the internal recti which this action demands. From one or more of these causes the

internal recti lose their normal power and the eye is everted; diplopia is the result, and to overcome this the patient mentally ignores the vision in the everted eye, which after a time becomes amblyopic.

APPARENT STRABISMUS.

APPARENT STRABISMUS.*—To determine if a strabismus is apparent or concomitant we cover, with the hand, one of the patient's eyes, and at the same time cause him to fix attentively the forefinger of the other hand with the uncovered eye. Now, while he steadily looks at the finger, we uncover rapidly the eye. If the eye which was covered does not move when the the hand is taken away, and he sees with that eye the finger distinctly, the strabismus is only apparent. A strabismus of this kind is generally divergent. If we find that the deviation is more pronounced in one eye than in the other, paresis of one of the muscles probably exists (p. 456).

CONVERGENT STRABISMUS.

STRABISMUS CONVERGENS.—We may suppose that one eye only is affected. If an object be held before the patient's face, and he is directed to look at it, the working eye is fixed on the object, but the squinting one is instantly inverted. If the working eye is closed, the squinting one turns slowly outwards, and is fixed on the object, but if the other eye is opened the squinting one again rolls inwards.

*Symptoms.*

Primary and secondary angles equal.

I have before explained the meaning of the term secondary angle of squinting, and laid it down as a rule that the secondary angle is always greater than the primary one in instances of paralysis; but that is not the case in strabismus, for if the working eye is closed, it will be inverted to exactly the same extent as the squinting eye is everted, when directed towards an object held before the patient's face.

In consequence of the inability of the two eyes to fix their optic axes on the same object, double vision exists; and in

* "A Manual of Examination of the Eyes," by Dr. E. Landolt, p. 45.

cases of internal strabismus the diplopia is direct, the image observed with the squinting eye being projected towards the corresponding temple (Fig. 61). Diplopia direct.

Double vision may disappear, because the rays of light in the squinting eye fall on the peripheral or less sensitive portions of the retina, and the impression after a time is ignored by the patient. If the squint be only slight, the image falls upon the retina near the macula lutea, and this part of the retina being very sensitive the confusion of vision becomes great, and to overcome this one eye is still further inverted. Sight of affected eye may be suppressed.

In the above remarks we have supposed only one eye to be affected, but this is by no means always the case. The squint may be *alternating*, appearing first in one eye and then in the other, so that if the apparently working eye is closed, the squinting eye assumes its normal position; but, in place of becoming again inverted when the former is opened, it may retain its natural position, and the other eye continue to be inverted. In fact, first one eye and then the other squints; it appears to be a matter of indifference to the patient which eye he uses, but he is unable to concentrate both his optic axes simultaneously on the same object; in these cases the sight of both eyes is nearly equally good. After some time, however, the sight in one eye becomes less acute than in the other, and the patient, finding this, rotates the least perfect eye inwards, and keeps it in that position, while he works with the other eye; in this way the strabismus becomes *fixed*. Alternating strabismus.

Strabismus having existed for some time, the beneficial effects of an operation upon the visual powers of the affected eye will depend upon its acuteness of sight. If the sight is pretty good, and the squinting eye can be steadily fixed on an object in front of it, while the working eye is closed, we may expect much benefit from an operation. But if the sight is already much impaired, and the patient cannot fix the squinting eye on an object, although the other eye is closed, we can hope to gain but slight, if any, advantage to sight from an operation. It is not advisable to operate for strabismus until a child is old enough to enable us to determine if his sight in both eyes is fairly good; and after the operation, to wear glasses to correct his error of refraction. In old cases must vary with state of vision, and power of fixing the eye. Age of patient.

*Treatment.* *Treatment.*—The methods which have from time to time been advocated for the cure of strabismus are numerous, but for all practical purposes we may confine our attention to tenotomy of the affected muscle, our object being to weaken the power of the muscle, and thus overcome the strabismus.

Glasses. No doubt much may be done, and must be done, by means of convex glasses in the case of hypermetropia, and of concave glasses in myopia, to overcome the abnormalities in the refractive media which induce a squint; but strabismus having been once acquired, division of the muscles which cause the squint is the treatment upon which my experience teaches me alone to rely (except in certain cases which will be subsequently referred to).

Tenotomy.

Often necessary in both eyes. I believe it is necessary to divide the muscle not only of the squinting, but of the working eye also, even in cases of monolateral strabismus, because the parallelism of the eyes is affected through means of a common motor influence. If the internal rectus of only one eye is divided, its tendon retracts and forms an attachment to the sclerotic further back than that of its normal position: the insertion of the muscle which has not been operated on is anterior to that of the internal rectus of the other eye, and is therefore longer (stronger), and has thus an advantage over the divided muscle when the eyes are made to converge on a near point. I consequently invariably divide the internal rectus in both eyes, and by putting back the attachment of both muscles equally, obtain parallelism of the eyes at rest, and also when converging. Many surgeons, however, prefer operating on one eye at a time rather than dividing both internal recti.

Muscles to be divided at their insertions. The relations of the tendons of the recti muscles to the capsule of Tenon have already been considered (page 2), and it is only necessary for me to add that in dividing the tendons of the muscles for the cure of strabismus, we must cut them through at their insertion into the sclerotic, so as not to disturb their connections with the capsule of Tenon more than we can help.

Operation. The patient having been placed under the influence of chloroform, and the lids separated with a stop speculum (the internal rectus being the muscle to be divided), an assistant seizes a fold of the conjunctiva with a pair of forceps, and everts the eyeball.

The surgeon then nips up a fold of the conjunctiva with a pair of fixing forceps at a line corresponding to the lower margin of the cornea, and well back towards the caruncle. The fold of conjunctiva below the forceps should then be cut through, dividing all the structures down to the sclerotic. It is very important completely to expose the sclerotic. The surgeon then takes a Cowell's strabismus hook, and placing its point on the sclerotic, runs it a little downwards, so as to get below the muscle, and then well backwards, so as to get behind it; the point of the instrument being still kept on the sclerotic, is then moved upwards and forwards, so that the extremity of the hook protrudes under the conjunctiva above the upper border of the muscle. The internal rectus is now to be put on the stretch, by drawing the hook towards the outer angle of the orbit, and while the tendon of the muscle is kept tense in this way the points of the scissors are to be introduced into the wound, the lower blade passing beneath the tendon in contact with the sclerotic, and the upper blade between the tendon and the conjunctiva. In this way the tendon of the muscle is to be cut through. The strabismus hook is then to be passed upwards and downwards against the sclerotic, so as to determine if any of the lateral offsets of the muscle have been left undivided; if so, they must be carefully cut through.

Division of conjunctiva.

Passing the hook.

The after-treatment consists in keeping the eye at rest for a few days; a cold compress may be employed for the first twenty-four hours after the operation.

As soon as the patient has recovered from the effects of the chloroform, we must examine the eye operated on, in order that we may ascertain the condition of the internal recti. It is evident that, if the operation has been successfully performed, the patient will still have some power of inverting his eyes through the attachments of the muscles to the capsule of Tenon, so that both eyes will converge upon an object held some six inches in front of the patient's nose; but when the object is more closely approximated to the face, the divided muscles should not have sufficient power to turn the eyes any further inwards.

Test the power of divided muscle.

In the course of three or four days the divided ends of the

Action of muscle partly restored.

muscles reunite with the sclerotic, at a point slightly posterior to their original insertion, and as the action of the internal recti becomes more powerful, the eyes act in unison, and the squint is cured.

Should it be necessary to divide either of the other recti muscles the operation may be performed after the method above described.

Defective sight.

We not unfrequently meet with cases of strabismus in young people, in which the sight of one eye is very defective, from want of use. In cases of this kind the squinting eye should be exercised in reading with a proper lens for three or four hours every day, the working eye being closed. Subsequently, we may divide the muscle of the squinting eye with considerable advantage, but harmony of movement can rarely be obtained, from want of sensorial guidance ; and we should consequently in such instances operate only on one eye. Among older patients the sight of one eye may be very defective, and in these circumstances the above rule still holds good, only operate on the squinting eye ; but the sight of this eye will seldom improve.

Strabismus effect of paralysis.

In cases of convergent strabismus depending on paralysis or weakness of the external rectus muscle, some surgeons are disposed to treat the case upon the principles I have already described (p. 460) dividing the internal rectus, and at the same time shortening the external muscle, always bearing in mind the fact that we must subsequently endeavour to give tone to the weakened (external) muscle by means of a well and long continued course of local Faradization.

Tenotomy in external strabismus.

*Divergent Strabismus*, as I have before explained, is commonly due to insufficiency of the internal rectus and myopia ; it may be produced from a defective operation for the cure of a convergent squint. In cases where the vision of one eye is very defective the eye often diverges : under these circumstances, for the sake of appearances, we may be called on to correct the squint, and shorten the internal rectus by a similar operation to that described at p. 460, and at the same time the external rectus should be divided subconjunctivally, so that its insertion may be placed further back. In fact, for the relief of all cases of divergent strabismus of this kind, our object must be to shorten

the internal rectus, or bring its point of insertion into the sclerotic forwards, while we lengthen (so as to lessen the power) of the external muscle, by dividing it, and allowing the retracted extremity to unite to the sclerotic behind the point of its normal insertion. But we unquestionably meet with instances of divergent strabismus in which the sight of the squinting eye is fairly good; in such cases favourable results frequently follow simple tenotomy of the external rectus of the diverging eye.

DOWNWARD SQUINT.—This affection of the eye is of rare occurrence, but the following case, given by Surgeon-Major Partridge, of Bombay, is a remarkably good illustration, not only of the symptoms, but also of the successful treatment of a case of the kind:—Captain E., aged about forty-five, came under my care in September, 1869, complaining of defective vision and strabismus. On examination, I found that he only, as a rule, used the right eye, and had acquired a habit of half-closing the lids of the left eye, to avoid confusion of images. If the right eye was covered he could see, though not clearly, with the left. When directed to look at an object distant about 12 inches, with both eyes open, the left eye turned directly downwards, or downwards and very slightly inwards. The right eye being covered, the left immediately came into position, showing a primary deviation of about 2 lines. The right eye being observed while the left was coming into position, the secondary deviation was seen to be equal to the primary, thus excluding the idea of any paralysis of the opposing muscle.

Downward Squint.

*Case.*

Testing the deviation.

Both eyes being uncovered, and he being told to look with the left eye only, the right eye was turned somewhat upwards.

On testing his vision, I found that with the right eye he could read No. 23 Snellen only at 10 feet, and that no spherical glass corrected vision, V = $\frac{1}{2}$. With the left eye he could read No. 20 only at 5 feet, V = $\frac{1}{4}$; and no spherical glass corrected vision. By means of the stenopaic apparatus, however, I found that in the right eye he had "simple astigmatism," being "myopic" in the vertical meridian ($\frac{1}{50}$), and "emmetropic" in the horizontal meridian; and that a concave cylindrical glass, with its axis horizontal, enabled him to read perfectly at 20 feet.

Testing the condition of vision.

In the left eye he had mixed "astigmatism," being myopic $\frac{1}{50}$ in a direction midway between the vertical and horizontal meridians, while he was "hypermetropic" $\frac{1}{40}$ in a direction at right angles to this. A combination of two cylindrical glasses (— 50) in the semi-horizontal direction, and (+ 40) in the semi-vertical direction, corrected vision up to 14 feet—a certain amount of amblyopia from forty-five years of disease preventing his reading fluently at 20 feet.

Treatment by operation.

"Taking into consideration that there was no paralysis, that diplopia could be produced by a prism, that vision could be corrected by suitable glasses, I saw no reason why an operation for the cure of the strabismus should not succeed, although it had existed for forty-five years! Accordingly, I placed him under chloroform, and divided the inferior rectus by the subconjunctival operation. There were no lateral expansions of the muscle, and the eye immediately righted itself, turning at first a little outwards; this, however, corrected itself after the first day. The eye is now quite straight, and all deformity is removed. When I last saw him he had not received his astigmatic glasses, but I have no doubt that, when he gets them, he will not only be greatly improved in appearance, but will enjoy good vision."*

NYSTAGMUS consists in a peculiar oscillation of the eyeballs; this oscillation is almost always in the horizontal direction. During the period of irregular movements of the eyes the patient complains of diplopia and an utter inability to pursue his ordinary avocation. Nystagmus generally first manifests itself in infancy, but it may be caused in after-life in certain circumstances. For instance, men employed in working in our coal mines have to carry on their avocation for hours together leaning on one side, with their gaze fixed above the horizontal line. Occupation of this kind not unfrequently leads to what is known as *miners' nystagmus*. In cases of this kind no lesion of the optic nerve can be recognized, but the oscillating movements of the eyes prevent the patient from continuing his work.

* *Medical Times and Gazette*, vol. i. 1871, p. 243.

The treatment of instances of miners' nystagmus consists in resting the eyes; after a complete cessation from work the muscles regain their functions, and the oscillations of the eyeballs cease. The relief is, however, usually temporary, the irregular movements of the eyes too often returning when the miner resumes his occupation. Rest is the only means which affords any relief in these cases. Among infants the nystagmus is generally associated with anomalies of refraction, together with opacities of the cornea or lens, and in many cases with irreparable lesions of the optic nerve or retina.

## CHAPTER XVII.

## ERRORS OF REFRACTION AND ACCOMMODATION OF THE EYE.

*General Considerations—Numeration of Spectacle Lenses—Emmetropia and Ametropia—Hypermetropia—Method of Detecting—Treatment—Spasm of Ciliary Muscle—Strabismus—Myopia—Symptoms—Treatment—Presbyopia—Symptoms—Diagnosis—Complications—Treatment—Astigmatism—Causes—Symptoms—Diagnosis—Treatment.*

Eye an optical instrument.

THE human eye has been compared to a camera-obscura, the retina corresponding to the ground-glass screen upon which the image appears, the object lens being formed by the association of two lenses juxtaposed (the cornea and the crystalline lens), with a diaphragm (the iris) interposed between them.

That a bi-convex lens is competent to produce a picture of the external world upon a screen placed behind it is a fact of which every one can assure himself by a simple experiment. If a lighted candle be held in front of such a lens, it will be easy to adjust the candle and lens so that a well-defined inverted image of the flame should be formed upon the screen. If the screen be now brought nearer to the lens the image of the flame thrown upon it will become enlarged and ill-defined; but it may be restored to its former distinctness by moving the lens a short distance away from the screen. By this simple experiment we learn, that a convex lens forms a distinct picture of a luminous object, at the exact point at which the rays of light are brought to a focus on the side of the lens opposite to the object, the focus being nearer the lens when the object is distant

Convex lenses.

Focus.

Distance from lens.

the rays of light passing through the lens being more nearly parallel, and further from the lens when the object is near, the rays being then divergent.

Lenses.

If the candle is kept in one position, and a stronger lens—that is, one having a greater convexity—be substituted for the first, the image of the flame on the screen will be blurred, and the lens will have to be moved nearer to the screen to give the image definition. If, on the other hand, a weaker lens, or one with less convex surfaces, be substituted for the first, it will have to be placed nearer to the candle, in order that the flame may be accurately focussed on the screen. In other words, the greater the convexity of the lens, the more quickly do rays of light passing through it come to a focus; and supposing the lens we were experimenting with were a perfectly transparent and elastic body, if we stretch it from its circumference equally in all directions we should render its surface flatter, and thereby lengthen its focus. Directly the force employed was discontinued the surfaces of the elastic body would bulge outwards, the lens would become more convex, and its focal distance would be shortened.

Accommodation.

The lens in the human eye is an elastic substance, which is compressed when at rest, because it is contained in a capsule which is kept in a condition of tension from its circumference by the suspensory ligament. When the ciliary muscle contracts, by pulling forward the ciliary processes and the choroid, the suspensory ligament is slackened, the capsule of the lens becomes relaxed, and its anterior surface immediately bulges forwards, by virtue of its elasticity, but returns to its flatter condition as soon as the ciliary muscle ceases to act. By the contraction and relaxation of the ciliary muscle, therefore, the anterior surface of the lens is rendered more or less convex, and so the power of the lens is proportionately increased or diminished; and in this way it is enabled to focus both parallel rays of light (those proceeding from a distant object) and also divergent rays (those emanating from a near object) on the retina.*

* I have purposely avoided referring to the laws governing the refraction of light, &c., in this chapter, because I think they may be studied to greater advantage in elementary works devoted to optics.

Paralysis of muscle.

If a solution of atropine is applied to the conjunctiva, the ciliary muscle fails to contract, and near objects appear indistinct; because, the muscle being paralyzed, accommodation is impossible, and divergent rays are not brought to a focus on the retina. Under these circumstances distant objects are still seen, parallel rays being brought to a focus on the yellow spot.

Accommodatory asthenopia.

We not unfrequently meet with patients who are weak and out of health complaining that their sight is defective; after reading for a short time the words become indistinct, they have difficulty in threading a needle, and so on, but they can see distant objects clearly. A condition such as this may arise from loss of tone in the ciliary muscle, which is unable to contract effectively for any length of time, so as to keep the suspensory ligament relaxed, and enable the anterior surface of the lens to maintain its convexity sufficiently to focus divergent rays upon the retina. This state of things is known as *accommodatory asthenopia.*

Binocular vision.

But this leads us to another point with reference to vision. To be accurate it must be binocular; the rays of light proceeding from any object must fall upon corresponding portions of the retinæ in both eyes. To effect this the eyes converge simultaneously, and to an exactly equal extent, upon any object that is gradually approximated to the observer's face. Under these circumstances, the pictures formed in both eyes are blended into one in the sensorium, producing a single image of accurate geometrical proportions. Vision by means of one eye is not accurate, for the retina only gives us an account as to direction, so that on looking at a hollow medal with one eye the idea produced is that the medal stands boldly out. In order to give an accurate perception of relief the two optic axes must cooperate, so that the image shall fall on identical spots of the retinæ of both eyes; the object so seen at different angles is associated in the brain so as to produce a picture of its true form and situation in space.

Muscular asthenopia.

Whenever the accommodation is exerted, convergence of the optic axes to a greater or less degree simultaneously occurs dependent upon the amount of that accommodation; in emmetropic eyes, convergence and accommodation are exactly balanced. Supposing, however, from the weakness of the in-

ternal rectus of one eye the patient cannot converge both eyes accurately on an object, or, having brought his eyes to bear on a point, he is unable to keep them steadily fixed on it, the external rectus being stronger than its antagonist, will evert this eye, and the patient's sight necessarily becomes confused. This condition is known as *muscular asthenopia*, and may be caused by weakness of any of the muscles of the eye.

Astigmatism.

I must again refer to our experiment, and suppose that the surface of the lens intervening between the candle and the screen is not perfectly spherical; for instance, if the surface of the lens (or in the eye of the cornea) in place of being spherical is of greater curvature in the vertical than in the horizontal meridian. Evidently rays of light passing through such a cornea or lens cannot be brought to a single focus at a point on the screen or retina, but possess two linear foci; the vertical being the stronger meridian will bring rays of light to a focus nearer to the lens than the horizontal or weaker meridian, and the image of the candle formed on the screen or retina will thus be blurred. This condition of things, if it exists in the human eye, is known as *astigmatism*. Irregularities of the surface of the cornea are, as a rule, the cause of imperfect vision of this description.

## NUMERATION OF SPECTACLE LENSES.

In the new or metrical system the metre is substituted for the inch in numbering glasses, the unit being made sufficiently small so that the number of the lens generally in use may be expressed in whole numbers. But as we require lenses having a focal distance of less than one metre, and also lenses of powers intermediate to the whole number, we employ fractions of a metre.

The unit is a lens of one metre focal length; for convenience it is called a *Dioptric*, and for the sake of brevity is written D. The sign + before a number means a convex glass; — a concave lens; Cyl., a cylindrical lens. Thus :—

+ 4 D. means convex 4 dioptrics.
− 4 D. „ concave 4 „
− .5 D. „ „ ½ dioptre.
+ .5 D. „ convex „

At the end of this chapter a table will be found showing the corresponding value of lenses under the old and present system of numeration.

## EMMETROPIA AND AMETROPIA.

Emmetropia. EMMETROPIA.—An eye is said to be *emmetropic* if when in a state of perfect repose (the ciliary muscle being relaxed) it is directed to a distant object, the rays of light proceeding from that object are brought to an exact focus on the retina. That is, the accommodation of the eye being at rest, parallel rays of light are accurately focussed on the yellow spot of the retina. The vision of such an eye for distant objects is perfect, and is disturbed by even a slightly convex lens held in front of it; it is not improved by a slightly concave glass.

If an emmetropic eye is examined by the direct method with the ophthalmoscope, at some distance, the disc appears blurred; but at 3 or 4 inches from the cornea a clearly defined, erect image is seen.

Ametropia. AMETROPIA.—Eyes which are not emmetropic are *ametropic*. In ametropia, the accommodation being at rest, parallel rays are not united on the retina, but are brought to a focus, either in front of, or else behind, the retina.

## HYPERMETROPIA.

Hypermetropia. A patient comes to us complaining that in reading, writing, and other close work, especially by artificial light or in a gloomy atmosphere, his sight fails him. After working for a short time he probably experiences a feeling of fatigue, the words he may be reading become confused. It may be he suffers from actual pain over the eyebrows, and symptoms such as these oblige him to discontinue the work upon which he is engaged. After resting his eyes he can see distinctly, and resumes his occupation; but the same train of symptoms are produced by a return to work. On examining a person's eyes affected in this way, they may appear to be healthy, with the exception of a slight amount of conjunctivitis, and the patient not unfrequently describes his sight as being particularly good; but if you place

*Symptoms.*

him at a distance of 20 feet from a card of test types, you will discover that he cannot clearly see the smaller letters ; he will probably also falter in reading No. 1 test type at 12 inches distance from his eyes ; in fact, both his far and near sight are imperfect.*

Unless in some exceptional cases of hypermetropia, to which I shall presently refer, the patient's distant and near sight are improved by convex lenses placed before his eyes.

Tests for hypermetropia.

Supposing a person comes to us complaining of symptoms such as those to which I have referred, we direct him to stand at a distance of 20 feet from the test type, and then, closing his left, we find with his right eye that he can see letters perhaps from No. 200 to No. 100, but he cannot make out any of the type beyond that number. We then take a weak convex lens, such as ·75 D., and place it in front of the right eye. If this glass improves the patient's sight, we remove it and place the next stronger lens before his eye, and so on until the most powerful convex lens has been found which most improves his sight, enabling him, perhaps, to see No. 25 at 20 feet. With this lens the patient will also very likely be able to read No. 1 type held at 12 inches distant from his eye.

Explanation of symptoms.

The conformation of the eye in a case like this is defective. In by far the majority of cases the globe is too short in its antero-posterior diameter, the retina being nearer the lens than it ought to be ; thus, when the patient's accommodation is relaxed parallel rays of light are not accurately focussed on the retina (Fig. 64). To overcome this defect it is necessary to bring the point at which the rays are focussed nearer the lens, so that they shall unite on the retina, and this may be done by placing a convex lens in front of the patient's cornea, so as to increase the refractive power of the media through which the rays pass before they reach his retina.

With such a condition of eye the patient unconsciously uses his ciliary muscle so as to increase the power of his lens, and by shortening its focal distance to unite the rays of light upon his

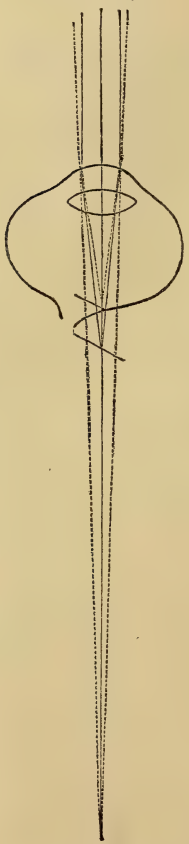
* The use of test types are explained at page 29, and at the end of this chapter a table of Mr. Cowell's test types will be found.

retina. By active accommodation a hypermetropic patient's far-sight may thus be rendered tolerably clear. But when this person is working at near objects, he is compelled to exert an extraordinary amount of accommodation in order to focus the divergent rays on his retina. This constant strain on the accommodation of his eye not only gives rise to congestion of its internal structures, and to pain, conjunctivitis, and so on, but the effort of accommodation cannot be continued beyond a certain point; and, the ciliary muscle growing weary, the convexity of the lens diminishes and the patient's sight instantly becomes blurred. A convex glass placed before the patient's eyes, by rendering rays more convergent, does away with the necessity for an inordinate amount of accommodation, which explains the relief hypermetropics experience from wearing convex glasses.

Necessitates recess of accommodation.

Use of convex glasses.

FIG. 64.



On examining the eye of a hypermetropic person in the manner I have referred to, it is evident that, when he endeavours to define the test letters at 20 feet, he may unconsciously make use of his ciliary muscle, and by increasing the convexity of his lens, shorten its focal distance, and thus overcome to some extent the defect in the formation of his eyes. And, as a matter of fact, hypermetropic persons, especially young ones, make very considerable use of their accommodation, even when looking at distant objects; indeed, children not unfrequently entirely overcome their hypermetropia in this way. In order, therefore, to discover the actual amount of hypermetropia which exists in any given case, it is necessary to paralyze the ciliary muscle with atropine.

Excessive action of ciliary muscle.

For instance, we find that a patient with his right eye at 20 feet can define the letters No. 100 of test types, but he cannot make out any of the letters beyond this number; we find that + 1 D. is the strongest lens with which he can see No. 20 at 20 feet. This gives us the degree of his *manifest* hypermetropia. We now direct this patient to drop a solution of sulphate of atropine, 4 grains to the ounce of water, into his eyes, night and morning, for three or four days; the action of the ciliary muscle is thus completely paralyzed; we then place him at 20 feet from the test types, and find that with his right eye, to see No. 20 in place of + 1 D., he requires + 4 D., and is said to have 1 D. of manifest, 3 D. of latent, and 4 D. total hypermetropia. In this way we ascertain, independently of the ciliary muscle, the amount of his total hypermetropia, or the real defect in the refraction of his eye.

Manifest hypermetropia; latent. Total hypermetropia.

As a rule, it is well to order a glass for such a patient of the mean strength between the amount of total and manifest hypermetropia. In the case we have been considering, + 2.50 D. would suit the patient after he had recovered from the effects of the atropine. The reason of this is, that most hypermetropic patients have become so accustomed to over-exert their accommodation, that they cannot suddenly suppress this habit, and so glasses which neutralize the whole of their hypermetropia would be too strong for them. In time, however, they lose the habit of overworking their ciliary muscle, and then they require to change their glasses for stronger ones than those we at first ordered for them.

Selection of glasses.

Hypermetropic patients should wear their glasses constantly. The defect of sight from which they suffer is a permanent one, and the strain on the accommodation which they employ to overcome their error of refraction is injurious to the eyes.

Constantly wear glasses.

In the case of the patient we suppose to be under observation, we closed his left eye and examined the right one, and having found out first the amount or manifest hypermetropia in the right, we now close this eye, and examine the left one in the same way. We may find the sight of this eye differs from the right, and that to see No. 20 the patient will require 2 in place of 1 D.; + 2 D. is the strongest glass which gives him clear

Examine both eyes.

distant vision with the left eye. After the application of atropine we find that + 6 D. is the most powerful glass with which he can read No. 20 at 20 feet with this eye.

Difference in refraction of eyes.

It is common to find the sight of the eyes differing in this way in cases of hypermetropia, and it is then advisable to order different glasses for the right and left eye. In this case we came to the conclusion that + 2·5 D. was the glass to order for the right eye; for the left, a difference between 2 D., his manifest hypermetropia, and 6 D., his total hypermetropia, will give us + 4 D. as the proper glass for the left eye, so that this patient's spectacles would on the right side contain + 2·5 D., and on the left side + 4 D., and these glasses he must wear constantly for both near and distant objects.

Young patients accommodate over hypermetropia.

From the above account of hypermetropia and the power a person suffering in this way has of overcoming his defective sight by an increased effort of accommodation, it follows that, in early life, when the vigour of the ciliary muscle is perfect, and the patient does not require to exercise his eyes overmuch on near objects, his defective vision may not be observed; it is only after close application to work that he is conscious of his imperfect sight. Symptoms of asthenopia then occur, or, it may be, a person having a slight degree of hypermetropia, manages to get on very well, until from some cause or other his general health falls below par, the ciliary muscle loses its contractile power, together with the other muscles of his body, and excessive accommodation being no longer possible, the defect in the refractive power of the eye becomes apparent. This leads me to explain how it happens that in a few exceptional cases patients suffering from hypermetropia appear to be benefited by concave glasses.

Spasm of muscle.

Among patients suffering from hypermetropia the ciliary muscle, from inordinate use, is apt to pass into a state of spasm, contracting so violently that the suspensory ligament is greatly relaxed, and the elastic lens bulges forwards to such an extent that rays of light are brought to a focus almost immediately behind its posterior surface, and therefore in front of the retina. Under these circumstances, concave glasses, by causing the rays of light to become more divergent, increase the length of the focal point,

and throw the image back upon the retina, and so improve the patient's sight, whereas a convex glass, by still further increasing the refractive media through which the rays have to pass, would increase the defect of sight; so that, although the patient's eye is hypermetropic, from spasm of the ciliary muscle, the focal distance of the refractive media is so much shortened that a concave glass is required to throw the image back on the retina. In a case of this kind, by paralyzing the ciliary muscle with atropine the patient will be able to see clearly with a convex, but not with a concave, lens. Such an eye should be kept under the influence of atropine for a fortnight or three weeks, in order, if possible, to break the ciliary muscle of the habit it has acquired of passing into a state of spasm. With proper convex glasses the patient's hypermetropia may then be neutralized.

Concave glasses improve hypermetropia.

Instances of spasm of the ciliary muscle are most frequently met with in a low or moderate degree of hypermetropia, but in cases of excessive hypermetropia myopia is sometimes simulated, the patient bringing his book, or any small object he may be engaged upon, close up to his eyes in the way a shortsighted person does. The reason of this is, that in excessive hypermetropia from long-continued accommodative effort, congestion of the deep membranes of the eye is induced, leading to a certain amount of amblyopia (loss of sight), and to overcome the defective sight the patient brings any small objects close to his eye so as to enlarge its retinal image. Beyond the advantage such patients gain from enlargement of the image, they are also able to bring an amount of forced convergence of the optic axes to aid them when the object is close to their eyes, and forced convergence, as I have already explained, is tantamount to an excess of accommodation, and also of contraction of the pupil. Apparent myopia is, however, exceptional in cases of hypermetropia, and if the ciliary muscle is paralyzed the error of refraction is at once detected, in that convex and not concave glasses assist the sight.

Most common in slight hypermetropia.

Under the heading of Presbyopia I shall explain the symptoms of hypermetropia when complicated with alterations in the lens or ciliary muscle, the result of advancing years.

yper-metropia plus presbyopia.

Medium or advanced hypermetropics, as a rule, complain of

symptoms of muscular asthenopia, but among young children it is often difficult to ascertain which of the test types they can really see; and under many other circumstances it may be very advisable to detect the existence and amount of hypermetropia independently of test types, and this may be done by means of the ophthalmoscope.

Ophthalmoscopic test for hypermetropia.

In consequence of the eyeball being too short from before backwards in cases of hypermetropia, it follows that, when the accommodation is at rest, both parallel and divergent rays passing through the dioptic media would be brought to a focus behind the retina; and conversely, the rays reflected from the retina of an hypemertropic patient will emerge from the cornea as divergent rays. If the retina of an hypermetropic eye is examined by the direct method with the ophthalmoscope, an erect image of the disc or of one of the retinal vessels may be seen at about 14 inches from the patient's eye—that is to say, the rays of light proceeding from the retina of an hypermetropic patient are rendered divergent by the refracting media, and are brought to a focus on the observer's retina at a distance of about 14 inches. That the image thus obtained is an erect one is proved by its moving in the same direction as the observer's eye; for instance, a patient is supposed to be hypermetropic; we examine his eye with the ophthalmoscope without a convex lens either in front or behind the sight-hole of the instrument. At 14 inches from the patient's eye we should see a clear and enlarged image of one of the retinal vessels; and if we now move our head to the left the vessel under observation disappears to the left beneath the iris; we move our head to the right, the vessel again appears, and is lost under the right margin of the pupil.

In order to ascertain the amount of hypermetropia by means of the ophthalmoscope we must place a convex lens in front of the sight-hole of the instrument of sufficient power to cause the divergent rays of light reflected from the patient's retina to become parallel before they reach the observer's retina. A suitable convex glass of this kind will thus overcome the fault of the refractive power of the patient's eye, and the number of the convex lens employed to accomplish this object is the measure of hypermetropia from which the patient suffers.

For instance, a child is brought to us suffering from imperfect sight; we examine his eye with the ophthalmoscope, and find that at 14 inches we obtain a clear and erect image of the patient's retina. The observer's accommodation being relaxed, he places a low convex lens in front of the sight-hole of his ophthalmoscope; the image of the fundus of the patient's eye is still erect and clear at 14 inches. One stronger lens after another is then applied to the sight-hole of the instrument, until we no longer obtain an erect image of the fundus, rays of light refracted from the retina having been converted from divergent to parallel rays in passing through the convex lens of the ophthalmoscope. The weakest convex glass which produces this effect is a measure of the hypermetropia from which the patient suffers, and must be ordered as the glasses which he is to wear to overcome his defect of vision. In making an examination of this kind it is, as I have before observed, necessary to relax one's own accommodation; with a little practice, however, there is not much difficulty in acquiring this power, and the ophthalmoscope then becomes a valuable aid in the diagnosis of hypermetropia.

Selection of glasses.

*Keratoscopy.*—In cases of hypermetropia the light and shade formed within the area of the pupil moves in a direction opposite to that in which the mirror of the ophthalmoscope is rotated (p. 38). To discover by this method the amount of hypermetropia, the patient's eye being under the influence of atropine, place a weak, and then a stronger, convex lens in front of the sight-hole of the instrument, until the image moves in the same direction as that in which the mirror is rotated. The weakest convex lens which thus converts the refraction from that of an hypermetropic into that of a myopic eye will be about 1 D. stronger than the lens we should order our patient to wear.

Keratoscopy test for hypermetropia.

*Strabismus* commonly results from hypermetropia; in fact, two-thirds of the cases of convergent squint are associated with hypermetropia. A squint, or want of co-ordinate action between the recti muscles, usually manifests itself in early life, in fact, as soon as a child begins to use his sight for near objects; it is caused in this way. Branches of the same nerve supply both the internal rectus and the ciliary muscle, and the stimulus which causes the latter to contract will effect the internal rectus

Strabismus in cases of hypermetropia.

in a proportionate degree. But in a hypermetropic eye the ciliary muscle is in a state of constant contraction, even for distant objects, which means a corresponding call on the two recti. Hence, for near objects the strain on the ciliary muscle becomes excessive. The patient converges more than the object fixed requires; he cannot see with the two eyes at once. One eye or the other is deviated inwards, in such a manner that the visual line passes to the proximate side of the object fixed, while the other fixes it accurately. In this way the foundation for a convergent strabismus is laid. Ultimately, the patient unconsciously finds out that it is preferable to mentally suppress the sight in one eye and look with the other, rather than to enjoy binocular vision, since the advantages of the latter are counterbalanced by the continual strain and fatigue on the recti (see *Strabismus*, p. 462).

## MYOPIA.

Myopia.

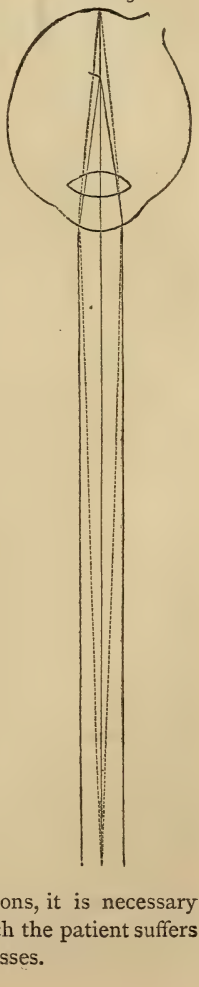
In cases of myopia the eyeball is too long from before backwards, so that when the accommodation is at rest rays of light are brought to a focus in front of the retina. The posterior part of the globe of the eye in myopia protruding so far backward that, although the cornea and crystalline lens may be normal, nevertheless, rays of light passing through them are focussed anterior to the retina. This condition of things may be illustrated by means of a candle, lens and screen. If the light and the lens are so placed that parallel rays from the candle are accurately focussed on the screen, which is then withdrawn a short distance backwards, the image of the candle at once becomes blurred. Under these circumstances, if a suitable concave glass is placed between the candle and the lens it will cause the rays of light falling upon the original lens to diverge to such an extent that they are accurately focussed upon the screen, and the image of the candle is then clearly defined.

Due to increased length of globe.

In some instances of myopia the length of the eye from before backwards has been known to measure a third more than that of the emmetropic eye, so that the patient's accommodation being at rest, it is impossible for parallel rays to be brought to a focus on the retina (Fig. 65). The pathological changes which

give rise to posterior staphyloma have been described (p. 310), so that at present we need only refer to the symptoms and the appropriate treatment of errors of refraction arising from this condition.

FIG. 65.



*Symptoms of myopia.*

The diagnosis of myopia is a matter of no great difficulty; the patient's distant vision is confused, but his sight is immediately improved if a suitable concave glass is held before his eyes. In the majority of cases, although the distant sight is very defective, vision for near objects is excellent. The reason of this is, that a myopic patient, from the peculiar conformation of his eyes, is able to define small objects brought close to his face, and the nearer the object is to the eye the larger is the image it forms on the retina. The power which short-sighted persons possess of seeing very small objects, is increased because their pupils are always largely dilated, and so they require less light to illuminate an object than people ordinarily do. But when we come to examine more closely into the condition of their sight, we find that scarcely 28 per cent. of myopic persons have a normal acuity of vision, and in a considerable number of cases one or both eyes are affected with a central scotoma arising from choroidal hæmorrhage, or from a posterior staphyloma which has invaded the polar region of the eye; detachment of the retina, softening of the vitreous, or a cataract, sometimes complicate cases of myopia. In order to guard a myopic eye from these complications, it is necessary to overcome the error of refraction from which the patient suffers in early life, by means of proper concave glasses.

Eyelids half closed.

Many short-sighted persons have a peculiar habit of half closing their eyes when looking at distant objects; the reason for this is, that by nearly closing the eyelids, the circles of diffusion of light otherwise formed on the retina are lessened. This fact may be demonstrated by rendering an emmetropic eye myopic by means of a convex lens held in front of the eye; such a lens makes all distant objects appear blurred, because the rays of light passing through it are focussed anterior to the retina. Under these circumstances, if the eyelids are half closed an improvement in vision is at once apparent for the reason above referred to.

Prominent eyes.

As a rule, myopic eyes are large and prominent; they feel somewhat hard on pressure, but the lengthening of the globe posteriorly is the essential feature of by far the majority of cases of myopia. This condition may be augmented through the increased pressure exercised by the ocular muscles on the globe of the eye (p. 310).

Convergence of eyes.

Muscular asthenopia and external strabismus are often met with in myopic patients. I have before remarked the convergence of the eyes on a near object and their accommodation takes place simultaneously, the one act provoking the other; but in cases of myopia, to see near objects it is only necessary for a person to use a very small amount of his accommodation in order that he may focus rays of light on his retina. The effort of accommodation being feeble, the act of convergence is also weak, and it requires an inordinate exertion on the part of a patient to force the internal recti muscles to converge the eyes upon a near object. At the same time, in consequence of the frequent ellipsoidal form of the eyeball in myopia, its mobility is restricted (see *Strabismus*). In myopia, therefore, the convergence of the eyes has not only to be maintained habitually because the patient is short-sighted, but this convergence has to be kept up by an inordinate action on the part of the internal recti muscles for the reasons above referred to, and hence the symptoms of muscular asthenopia and external strabismus are acquired by myopic patients. To overcome the trouble to vision caused by the diplopia, the patient acquires the habit of mentally ignoring the sight in the diverging eye, and ultimately

it becomes amblyopic. Dr. Landolt, however, explains this condition as follows. He remarks that a myope demands but little accommodation. Now he can most easily relax the accommodation by converging as little as possible. When this tendency is pushed to excess it ends in the exclusion of one eye from vision, and renders the visual lines for near vision nearly parallel, and for distant vision divergent. This is the beginning of the strabismus divergens, which shows a tendency to increase, especially when it is confined to one eye.

Asthenopia.

A short-sighted person suffering from muscular asthenopia complains of symptoms very similar to those of a patient affected with accommodatory asthenopia. His vision is perhaps clear when he commences his work, for he can then bring his optic axes accurately to converge upon it. But after a certain amount of work his eyes fill with tears. The patient experiences a sensation of weariness and slight aching pain, and he is compelled to discontinue his occupation; after a period of rest he can resume his work for a limited time. Inflammations of the margins of the eyelids, styes, and epiphora are—together with headache—frequently met with in myopia; these symptoms are induced by abnormal muscular tension, and are only to be cured by the use of proper glasses.

We frequently find, especially among young people affected with perhaps only a slight amount of myopia, that symptoms of accommodatory asthenopia exist, and on examining their eyes with the ophthalmoscope we find that the optic disc is extremely congested. In the greater number of such cases excessive spasm of the ciliary muscle exists, and this must be overcome by keeping the muscle paralyzed for a month or six weeks by the instillation of a strong solution of atropine. After the effect of this drug has passed away the patient must be supplied with proper concave glasses.

Ophthalmoscope in myopia.

*Ophthalmoscopic Examination in Myopia.* — The direct method of examination being employed, in consequence of the abnormal length of the eyeball from before backwards, rays of light emerging from the cornea intersect immediately in front of the myopic eye, so that the image they form on the observer's retina is an inverted one. If the observer be nearer the patient's

eye than where the rays unite, he will not see the optic disc. So that, if on going close to the patient the observer cannot see any details of the fundus, clearly the patient is myopic. But if the observer's eye is sufficiently far removed from the patient's to receive the convergent rays optic after they have united and crossed, he will see an inverted image of the disc. The inverted image moves in the opposite direction to that of the observer's eye.

*Keratoscopy.*—In cases of simple myopia the image of light and shade move in the same direction as that in which a concave mirror is rotated, and the rapidity of movement and curvature of the shadow are the same in all meridians.

*Treatment of myopia.*

*Treatment of Myopia.*—Supposing a patient applies to us complaining that he is unable to define distant objects clearly, but can see small type held close to his eyes, we direct him to place himself at 20 feet distance from the test types, and we examine first one eye and then the other; it may be at this distance the patient can make out letters No. 100 with the right eye, but with the left can only see No. 169; we then ascertain the *weakest concave* glass with which the patient can distinctly make out No. 25 at 20 feet, first the right eye and then the left being examined. The *weakest* concave glasses which give the best attainable sight at 20 feet may be ordered for a patient not suffering from a high degree of myopia; these are the only glasses he will require either for near or for distant vision. It is necessary to be careful to order the *weakest* concave lens which gives the best attainable sight at 20 feet, because with a more powerful glass the patient may see equally well by making use of his accommodation, and so neutralizing the divergent action on the rays of light of the too concave lens. It is in this way that an emmetropic, or even a hypermetropic eye, may see clearly with a slightly concave lens held before it.

Concave lenses.

Object of treatment.

We must bear in mind the fact that the treatment of short-sighted patients by means of lenses is to be directed towards increasing the distance at which near and far objects may be clearly seen. It requires a little practice, however, for an individual first using concave lenses—especially for near objects—to overcome the habit he has formed of exerting an inordinate amount of convergence of his eyes on the object, so that for near sight he may object to glasses which neutralize his myopia for distance

Unless, however, a short-sighted person can see ordinary size print, or work at 12 inches, it is advisable for him to use concave glasses, because it is when employed on near work that accurate images are necessary, and these the myopic patient can only obtain by harmful approximation of the object to his eyes. The only way to overcome this difficulty is by the use of concave lenses. Spectacles are less necessary for distance, because a short-sighted person may, if he chooses, pass through the world and only see a small portion of it; though he thus loses the advantage of the unconscious education which observance of the world and its ways imparts.

Lens for best eye.

The question frequently arises with reference to the advisability of neutralizing a difference which may exist in the eyes of myopic patients—are we to attempt to overcome this difference by appropriate lenses for the right and left eye. The rule is in cases of this kind not to order lenses of different power for the two eyes, but to furnish both eyes with glasses that suit the best eye; for instance, —4 D. is the weakest lens which gives the best sight to the right eye, but the myopia in the left eye is neutralized by — 5 D. Do not order No. 4 for the right eye, and 5 for the left, but give the patient —4 D. for both eyes. In some few cases it may be necessary to obtain the best possible vision, and to try and overcome the difference between the two myopic eyes with appropriate lenses for each eye; under these circumstances, however, the vision is not unfrequently rendered indistinct, in consequence of the unequal size of the retinal images formed by lenses of different powers. As I have before remarked, there are exceptions to the above rule; in consequence of the existence of excessive posterior staphyloma, or some other complication, the vision is so indistinct that the patient has to bring objects quite close to his eyes in order that he may see them. To overcome this condition a concave lens of high power may be necessary, but the image of the object is so much reduced in size that the already imperfect retina is unable to appreciate it. Under these conditions, insufficiency of the internal recti muscles may complicate the case. If a myopic patient's sight is therefore so defective that he is unable to read No. 3 types unless he brings the type to within 3 or 4 inches of his eyes, it is *not* desirable to order spectacles for reading or near work.

It is a matter of some importance that glasses for correcting myopia should be placed close to the eyes; for if concave lenses are placed at an unnecessary distance from the eyes it may lead to the employment of higher powers than would otherwise be required.

High degrees of myopia.

Suppose that a myopic patient can read about 5 of Cowell at 12 inches, but not beyond that distance. If we give such a patient the weakest glasses for reading which neutralize his myopia for distance, he is apt to complain of pain in his eyes when he attempts to use these glasses on near objects in order to focus the divergent rays of light on his retina. He has, in fact, been accustomed while working at near objects to relax his accommodation. If we give him strong concave glasses which entirely neutralize his myopia, and which would therefore necessitate his employing his full power of accommodation for near objects, the ciliary muscle not being accustomed to work of this kind fails to respond to the demand made upon it. Under these circumstances order the weakest glasses by which the patient can see 2 or 3 test types at 16 inches. After he has worn these for a time, and brought his ciliary muscle into working order, he will probably take to stronger glasses.

Presbyopia and myopia.

It is generally supposed that as short-sighted persons advance in years their myopia will be neutralized by presbyopia; but when we remember that the latter condition is simply a senile insufficiency of accommodation, it follows that myopics, although they may not be aware of the change, are nevertheless affected by it. As a rule, however, short-sighted persons do not require spectacles before they are sixty years of age, and are then often benefited by weak convex glasses for reading and concave glasses for distance. Should their myopia have been of high degree, so that the patient is unable to read No. 2 or 3 test types beyond 8 inches, then, as complete loss of accommodation is brought about by advancing years, they will still read clearly at about 8 inches, but will not see distinctly either beyond or within that distance; and so as a rule no glasses are required in such a case, the patient is presbyopic without knowing it.

Correction of myopia by ophthalmoscope.

Some further observations on cases of myopia complicated by presbyopia will be found in the next section.

We can form an idea of the degree of myopia by means of the

ophthalmoscope ; for, as I have already explained, we get an erect image of the fundus of a myopic eye if we place the ophthalmoscope very close up to the patient's eye ; but to obtain an erect image beyond the point at which the converging rays cross, we must fix a concave lens behind the sight-hole of the instrument ; and the strength of this correcting lens will enable us to form an idea of the degree of myopia from which the patient is suffering ; *provided that in making the examination we can ignore the fact that we are looking at a near object, and use no accommodative effort*, so as to allow parallel rays of light to be focussed on our retina. The reason of this is, that if we advance the ophthalmoscope sufficiently near to the myopic eye, we shall receive from it converging rays which will form an erect image on our retina. But beyond the point at which these converging rays cross one another an inverted image would be focussed on our retina, unless the converging rays are rendered parallel by means of a concave lens placed in front of our own emmetropic eye. The weakest concave lens, therefore, which renders these converging rays parallel, so as to enable us without any accommodative effort to observe an erect image of the patient's retina, will give us an idea of the existing myopia.*

* The following table, compiled by Mr. Edgar Browne, shows at a glance existing errors of refraction as demonstrated by the ophthalmoscope :—

| | *Adapted in Rest for* | *Parallel Rays Focussed* | *Rays from Retina Emerge as* | *Image by Direct Method* | *Erect Image Seen Close* | *Image by Indirect Method* |
|---|---|---|---|---|---|---|
| EMMETROPIA. | Parallel rays. | On the retina. | Parallel. | Erect, virtual, seen close. | Without correcting eye-pieces. | Not affected. |
| MYOPIA. . . | Divergent rays. | In front of retina. | Convergent. | Inverted, real, seen at distance. | With concave. | Made smaller. |
| HYPERMETROPIA | Convergent rays. | Behind retina. | Divergent. | Erect, virtual, seen at distance. | With convex. | Made larger by moving objective closer to eye. |

Correction of myopia by keratoscopy.

*Keratoscopy.*—This method of examining the eye has been already explained (p. 38). If the image of light and shade formed on the retina moves in the *same* direction as that in which the concave mirror is rotated the case is one of simple myopia. To determine the amount of the myopia we must place first one and then another concave lens in front of the patient's eye, until we find that the image moves in the opposite direction to that in which the mirror is rotated. Supposing we find the light and shadow moving in the *same* direction as the mirror with a concave 3 D. lens in front of the patient's eye. We then try 4 D. ; if the image now moves in the opposite direction the myopia is not more than four dioptrics, if it is were the concave 4 D. would have left some of the myopia uncorrected. So that the myopia is therefore between 4 D. and 5 D.

*Causes of myopia.*

Myopia is largely due to civilization ; that such is the case is evident to those who have had to deal with masses of people removed from the centres of civilization ; among such people myopia is almost unknown, whereas, from statistics elaborated in Germany, of 10,000 students, no less than 1,800 were found to be suffering from defects of refraction. Of these 1,000 were due to myopia; in ten cases the affection was hereditary. Among the children of village schools the percentage of children affected with myopia was 1·4, whereas it rose to 11·4 per cent. in the town schools. Of these latter in the primary schools myopia affected 6·7 per cent. of the scholars, in medium schools 10·3 per cent., and in the high schools 26·2 per cent. In the high schools more than half of the pupils in the upper classes are myopic. Myopia is in this country frequently acquired by those who have to do fine work, often carried on in a bad light, as in the instance of watchmakers, engravers, &c.

Preventative treatment.

These facts speak for themselves : it is evident that among young people the constant application of the eyes to near objects, such as reading and writing, causes myopia. This result is increased in proportion as the light is imperfect, or from faulty position of the scholars the book or writing upon which they are engaged is brought too close to the face ; over-work, therefore, especially in a bad light, is the direct cause of myopia. The secondary causes are bad print, too small a type, and slight

haziness of the cornea. In fact all those conditions which oblige young persons to seek a larger retinal image by the approximation of the object under observation close to their eyes, consequently a good side light and properly arranged desks, together with well-printed books, should be provided by all school authorities; and if myopic pupils are found who cannot read small type with comfort at 12 or 14 inches from the eye, they should wear concave glasses.

## PRESBYOPIA.

Presbyopia.

From the age of twenty to three score years and ten the acuity of vision decreases, but, in addition to this, the accommodative energy diminishes with advancing age, the ciliary muscle gradually losing its power and the elasticity of the lens diminishing, so that by the time a person is forty-five years of age he is unable to focus near objects on his retina. It is evident, however, that small print must be held within a distance of from 12 to 13 inches from a person's eyes in order that a sufficiently large image of the letters may be formed on his retina to enable him to see them distinctly. The necessity for approximating an object like this to the eye is increased if the sensibility of the retina to light diminishes, as it does with advancing years; consequently in aged persons, as the nerve becomes less sensitive, obliging the individual to bring small objects close to his eyes, his power of accommodation fails him, and so symptoms of presbyopia are induced. Such a person can see clearly at a distance, and with a proper convex lens can define the smallest type at twelve inches from his eyes.

Age at which it usually commences.

Glasses.

A patient, forty-five years of age or upwards, comes to us stating that he has had excellent sight all his life, but that he now finds difficulty in reading small type, especially by candle-light. He can see No. 25 at 20 feet, but cannot read No. 1 at 12 inches. He can perhaps make out No. 4 if the type is held 16 inches from his eyes. With + 1 D., he sees No. 1 at 12 inches from his eyes, but these glasses disturb his distant vision; in fact, he sees better without glasses, unless for reading, writing, and such like work.

Patients suffering from presbyopia instinctively seek a bright

Light.

light, so that they can sometimes see small type without glasses if a bright light is placed between their eyes and the book they are reading. The reason of this is, that in a very bright light the pupil contracts so completely that the circles of diffusion otherwise formed on the retina are diminished, and the individual's sight is in this way improved. That the contraction of the pupil is the cause of the improvement of vision is demonstrated by the fact that presbyopic persons, when looking through a pin-hole in a card, find that their sight is improved; a test of this kind is useful to distinguish errors of refraction from loss of sight depending on disease of the retina or some of the deep structures of the eye, which would not be assisted by looking through a minute hole.

The correct lenses to overcome presbyopia depend upon the age of the individual; the rule is, at forty-five years of age to order + 1 D., and increase the strength of the glasses, as in the following table :—

| Age. | Dioptres. | Age. | Dioptres. |
|---|---|---|---|
| 45 | 1 | 65 | 4.50 |
| 50 | 2 | 70 | 5.50 |
| 55 | 3 | 75 | 6 |
| 60 | 4 | 80 | 7 |

Hypermetropia and presbyopia.

There are however exceptions to this rule, for instance, a person has been slightly hypermetropic all his life, but through the aid afforded him by his ciliary muscle he has overcome his defective refraction, and managed to focus both parallel and divergent rays of light on his retina. But when this person arrives at about the age of forty or forty-five, his ciliary muscle becomes less active, and his lens firmer, so that he now has difficulty in overcoming his hypermetropia by any effort of accommodation, and so both his near and far sight are defective. In a case of this kind at 20 feet the patient may be unable to see any of the letters beyond No. 100, but with a + 1 D. he reads No. 25, so that we may presume that about + 1·5 D. will cover his hypermetropia, but as this individual is forty-five years of age, he will require + 1 D. convex to neutralize his presbyopia, consequently we order him

Selection of glasses.

glasses of + 1·50=2·50 + D. As the patient advances in life, he will require an increase of one dioptric for every five years, in addition to the + 1·50 dioptrics to cover his hypermetropia. For instance, a patient has always worn + 4 D. lenses to overcome his hypermetropia, and he is now sixty years of age; for his presbyopia he requires + 4 D., add to this + 4 for his hypermetropia, and we order + 4 D. for reading, writing, and so on, but for ordinary use at a distance this individual only requires + 4 D. No. 8 would greatly inconvenience him, and to overcome this condition of things, his spectacles may be so arranged that the upper portion of each glass contains a + 4 D., and the lower half + 8 D. Under these conditions in raising his eyes for distant objects, the patient looks through + 4 D. glasses, and in casting down his eyes for reading and writing, he sees through + 8 D.

Retina less sensitive with age.

Lastly, with advancing years the near point of vision not only recedes from the eyes, but in different degrees among various people the retina becomes less sensitive to light, so that some presbyopic people are obliged, as far as possible, to enlarge the retinal image of all small objects, such as printed matter upon which they may be engaged; and to increase the size of the retinal image they are in the habit of bringing the type close to their eyes although using powerful convex glasses. The habitual approximation of small objects to the face necessitates an increased convergence of the eyes upon the object, and as in these cases the accommodation is in abeyance, discord in what should be harmonious action is the result with a proportionate amount of strain on the eyes, and not unfrequently increased intra-ocular blood stasis and faulty nutrition of the retina and other structures of the eye. We may, however, overcome this difficulty by directing the patient to read with a hand (convex) glass through which he looks with one eye, and thus prevent the necessity for converging his eyes on the object upon which he is engaged.

## ASTIGMATISM.

Astigmatism.

By astigmatism we mean that condition of one or both eyes in which the curvature of their vertical, horizontal, or some one

or more of the intermediate meridians of the eyes is not perfectly spherical; it may be one of these meridians is more convex than some other meridian; in fact, there can be endless varieties of this kind, but for all practical purposes we may confine our attention to irregularities thus caused in the refraction of the eyes by congenital anomalies in the curvature of the cornea. I say congenital anomalies, because I need not here refer to those cases of astigmatism resulting from a wound of the cornea such as that which is sometimes met with after extraction of a cataract, conical cornea, and so on. For the same reason I may exclude those obscure cases of astigmatism resulting from defects in the lens, whether congenital or arising from irregular action of certain fibres of the ciliary muscle.

Definition. By astigmatism we mean that condition of an eye in which the curvature of its different meridia are not equal. In the sense in which we shall use the term, the fault in the refracting meridia of the eye depends on irregularities of the curvature of the cornea, deviating to such a degree from the spherical form as to interfere with the perfection of sight, and so some of the rays, from any radiant point in view, are brought to a focal line instead of a focal point on the retina.

*Causes.* It is evident if an irregularity in the curvature of the cornea exists that rays of light passing through such a cornea must be irregularly refracted, and cannot all be brought to the same focus on the retina, so that an object seen by such an eye is blurred and indistinct.

*Symptoms.* For instance, a person about twenty-five years of age consults us, complaining that so long as he can remember, his sight has been defective for both near and distant objects. On examining his eyes we find their tension is normal, the media transparent. The patient cannot read small type, and his distant vision is imperfect, but on holding a card close to one of his eyes, and telling him to look through a pin-hole or narrow slit in it, he finds that his vision is improved. He also notices that when he is standing at some distance from a clock, and closes one eye, with the other he can see some of the figures on the dial much more plainly than others. The horizontal bars of a window are distinct, and the vertical ones

less so. It is not uncommon for patients affected in this way to be able in some degree, for a time, to overcome their defect of sight by means of an effort of accommodation; but if this power fails them their vision becomes very imperfect, and so patients affected with astigmatism not unfrequently complain of symptoms of asthenopia in addition to the more permanent defect of vision above referred to.

Tests for astigmatism

A case of this kind does not depend on amblyopia; in other words, on defect of sight due to serious changes in the deeper tissues of the eye; for if such were the case the patient's vision would not be improved when he looks through a small slit cut in a card. As we before stated, if the surface of his cornea is not perfectly spherical, rays of light falling upon it cannot all be brought to the same focus on the retina; but if the patient under these circumstances looks through a slit in a card held close to his eye, this small opening cuts off many of the lateral rays, and only allows of the passage of a minute pencil of light, which, falling upon an equally small extent of cornea, and passing through this, is accurately focussed on the retina, being uninfluenced by the surrounding irregularities of the cornea. In this way the patient's sight is improved when he looks through a slit in a card.

Defects in sight.

Again, a person suffering from astigmatism, with his accommodation paralyzed, may see the horizontal bars of a window at 20 feet distance, but cannot see the vertical bars distinctly, because the refracting media of the vertical meridian of his eye are emmetropic, but its horizontal meridian is too flat (hypermetropic) to admit of the rays which pass through it being focussed on the retina, and the individual consequently cannot see the vertical, but only the horizontal bars of the window. If under these conditions the patient bends his head over to one side so as to bring the vertical meridian of his eyes into the horizontal position, he thus sees the upright bars of the window distinctly, but not the cross ones.* It is evident

* The meaning of this is that the rays of light falling on the vertical meridia are those which come from the borders of horizontal lines, and so the cross bars of the window are seen. But the upright bars cannot

that faults in the asymmetry of any of the other meridians of the cornea would cause symptoms of astigmatism equally with imperfections in its horizontal or vertical meridians.

Distortion of lines.

The patient can see large objects, but their outline is distorted and often surrounded with greyish coloured halos consequent on the irregular refraction of the rays of light in their passage through the cornea. But it is important to bear in mind the fact that the absence of clear vision dates back as long as the patient can remember, although, as I have before remarked, he may have been able to overcome part of the error of refraction by means of his power of accommodation, especially before and for some few years after the adult period of life.

It is remarkable that extremely few persons' eyes are absolutely free from astigmatism; but so long as the defect only amounts to such a degree as but slightly interferes with vision, it is not recognized. As a rule, those cases of astigmatism that come under the care of the surgeon for defects of sight depend on the vertical meridian being emmetropic, and the horizontal hypermetropic. Let us suppose that this condition of one or both eyes exists; it is evident that the rays of light passing through the vertical meridian will be brought to a focus on the retina, but that those passing through the horizontal meridian would be brought to a focus behind the retina, and so the picture of any object formed on the nerve must be blurred. In such a case we order glasses which do not interfere with the refraction of the rays passing through the vertical meridian, but which are sufficiently convex in the horizontal to bring the rays passing through this meridian also to a focus on the retina. In other words, the glasses must be plane in the vertical and convex in the horizontal meridian. Lenses of this kind, intended to equalize the refraction of meridians of the eye, are called cylindrical lenses, being the segments of a cylinder instead of a sphere such as ordinary lenses are. The surface of these cylindrical lenses are parallel in one direction, but are either concave or

Cylindrical lenses.

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be seen, because the rays which proceed from the sides of vertical lines strike the plane of the horizontal meridia, which plane in the case under consideration is supposed to be hypermetropic.

convex in the other direction, and consequently they only refract the rays of light passing through the latter plane.

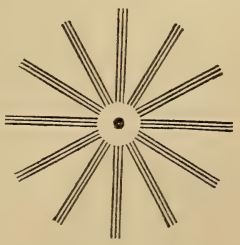
Ophthalmoscope in astigmatism.

It is evident for the same reason that the picture formed on the retina of a person suffering from astigmatism is imperfect, so the rays of light reflected from the back of such an eye will be unequally refracted on emerging from the cornea, consequently the optic disc of such a person's eye examined with the ophthalmoscope is distorted, instead of appearing to be circular it looks more or less oval. In cases of simple hypermetropic astigmatism, by the direct method of examination the long axis of the disc corresponds to the meridian of the eye having the greatest refraction, and is therefore nearly vertical. By the indirect method the direction of the long axis of the disc is generally more or less horizontal, its shape varying on withdrawing the lens from before the patient's eye, the image enlarging either absolutely or relatively in the direction of the meridian of greatest refraction.

Selection of glasses.

*To ascertain the presence of Astigmatism.*—In the first place the patient's sight must be tested for hypermetropia or myopia, as the defect of sight from which the patient suffers may be due to errors of refraction depending on one or other of these causes. If such is not the case, the patient's accommodation being paralyzed, he should close one eye, and standing about 15 feet from Snellen's half circle of radiating lines, must be directed slowly to approach the card until he sees at least some of the radiating lines clearly (Fig. 66). Convex and concave spherical lenses are then held before the patient's eye until the highest convex or lowest concave lens is found through which the individual sees the lines which were previously indistinct on the card. The spherical lens which thus brings the indistinct lines clearly into view indicates the strength of the cylindrical glasses required to overcome the defect in the refraction of the faulty meridian of the patient's eye.

FIG. 66.



For instance, supposing that the vertical meridia are emme-

tropic and the horizontal hypermetropic, the patient being under the influence of atropine, we find that he sees the horizontal lines. But to enable him to define the vertical bars clearly he requires a+2 D. to be placed in front of his eye. If we provide such a patient with a cylindrical lens (+ 2 D. Cyl.) with its curvature fixed horizontally (its axis being vertical) the rays passing through the horizontal meridia will be concentrated by the lens and brought to a focus on the retina, while the rays passing through the vertical meridia not being altered by the glass will still be focussed on the retina.

Astigmatism may exist in addition to myopia or hypermetropia, in which case it is necessary to correct those errors of refraction by means of proper glasses which must be applied to the eyes when testing them with cylindrical lenses to overcome their astigmatism.

The resident Medical Officers of Institutions such as the Royal Westminster Ophthalmic Hospital, have, as a rule, daily to work out a considerable number of cases of astigmatism among the out-patients, and have thus ample opportunies of testing the value of the various methods at present in use for detecting and correcting errors of refraction depending upon this cause. The following remarks on the subject have been drawn up for use by one of our most painstaking and experienced officers, Mr. Winkley Langdon. He remarks :—

" On testing all cases of astigmatism it is necessary to put the eye fully under the influence of atropine, more especially so in the hypermetropic forms. This having been done, place the patient at six metres from the test types, and with spherical lenses improve the vision as much as possible; now rotate in front of the eye thus corrected, a stenopaïc slip, until the least ametropic meridian is found, and by adding weak spherical lenses, ascertain whether we have over or under corrected it : if either, replace the lens behind the stenopaïc slip, by the most correcting lens for this meridian; now turn the stenopaïc slit exactly at right angles to its former position, which of course will be opposite the most ametropic meridian, and by proceeding in an exactly similar manner, find out accurately the amount of ametropia in this meridian. The difference of refraction between

the two meridia thus tested, will give the amount of astigmatism and the strength of cylindrical lens requisite for its correction, which should always corroborate with the test lens before prescribing the glasses.

"To make the above method more clear, let us take for example an actual case of compound hypermetropic astigmation (that is with H in both principal meridia, but more in one than the other).

"Having placed the patient at 6 metres from the test types, we find that with a + 3 D. spherical, we bring the acuteness of the vision (V) from $\frac{6}{24}$ to $\frac{6}{18}$; now place in front of the + 3 D. (which is fixed in the posterior rim of an accurately adjusted astigmatic frame) the stenopaïc slit, and rotate it until we find the greatest improvement (in this case it will be when the slit is in the vertical or near the vertical meridian); V is now perhaps $\frac{6}{12}$; then put a + 0·50 D. spherical in front of the slit and find V = $\frac{6}{9}$, we have evidently over-corrected the H in this meridian, which is only + 2·50 D.; now replace the + 3 D. in the posterior rim by + 2·50 D. and rotate the slit exactly at right angles to its former position; proceeding with this meridian (the more hypermetropic) precisely in a similar manner, we find that by adding + 1·50 D. spherical, V again = $\frac{6}{9}$: the H in this meridian is evidently + 2·50 D. + 1·50 D. = + 4 D., and the eye has + 1·50 D. of astigmatism.

"We should then corroborate the result by trying either of the following combinations, + 2·50 D. spherical with + 1·50 D. cyl., axis vertical, or + 4 D. spherical with 2·50 D. cyl. axis horizontal: which would correct the total ametropia in the eye under examination, and theoretically would be the proper glass to order, but practically we find (more especially in hypermetropic astigmatism, in which state the ciliary muscle has from constant over-use become hypertrophied) that we cannot neutralize the whole H; so that, in such a case as the above, we should order for constant use + 1·50 D. spherical with + 1·50 D. cyl.; thus correcting all the astigmatism and about half the total H."

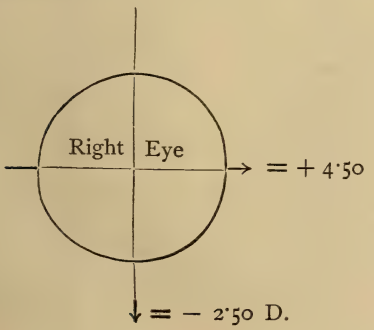
The above method of testing astigmatism is the most rapid and, with unintelligent patients, least irksome and most definite, as actual test-type letters are substituted for relative terms of

clearness, which latter, with patients of the above class, are utterly unreliable.

Tests such as those I have referred to are sufficient to overcome by far the greater number of cases of astigmatism; the more complicated instances (mixed astigmatism) are comparatively rare, in which one meridian may be myopic or the other hypermetropic, and so on. I know of no more effective means of testing these cases than by keratoscopy, a method which my colleague, Mr. A. Leahy describes as follows:—

The patient being fully atropised, is placed in a chair, with the light just above his head, and the surgeon takes his seat immediately in front of him, and at a distance of about 48 inches. The room should be darkened, and the mirror used must be *concave*, and should have a focal length of not less than 22 cm. (9 inches). The patient is now told to look at the wall behind the observer, just above his head. The light is thrown by the mirror upon the front of one eye (say the right), and the area of the pupil well illumined, when an image or shadow of the lamp used is seen. The mirror is now carefully rotated in a vertical direction, and the shadow attentively watched. If the shadow now moves in the same direction as the mirror, the vertical meridian of the eye is myopic, and we proceed to find the degree of myopia in this meridian. For this purpose, place in front of the eye, in a pair of spectacle frames, a —1 D., and again directing the light on to the eye, look carefully at the shadow while we rotate the mirror, and we still find that it is myopic. We now replace the — 1 D by — 2 D., and repeat our observation, with the same result, that in the vertical meridian the patient is still myopic. Taking away the — 2 D., we replace it by — 3 D., and again examine the patient, when we find the shadow of the vertical meridian moves in the *opposite* direction to that in which we rotate the mirror; we have thus evidently over-corrected the myopia, and we now try a concave lens whose strength lies between — 2 and 3 D.—viz., —2·50 D.; and upon again examining with the mirror the illuminated pupillary area can hardly be said to have a shadow. We therefore conclude the myopia in this meridian is corrected by a — 2·50 D. lens. The observer now proceeds to discover and

rectify the error of refraction in the other meridian—viz., the horizontal. Removing the — 2·50 D., and starting by well illuminating the area of the pupil, he rotates the mirror horizontally—*i.e.* from side to side, and closely watches the shadow, which on this occasion is found to move in the opposite direction to the rotation of the mirror. Now, adjusting the spectacle frames, place in front of the patient's eye a +1 D., and again carefully note the direction of the shadow, which is still found to move in the opposite direction. The surgeon now concludes the patient's eye is hypermetropic in its horizontal meridian, and proceeds to find out the degree of hypermetropia in the same way as in the myopic meridian, only using *convex* instead of concave lenses. In this way he finds that a + 5 D. gives a shadow which moves with the mirror, or which is myopic in direction; or, in other words, that a *convex* +5 D. over-corrects the hypermetropia; he therefore tries a + 4·50 D., and on examining the illuminated pupil finds there is hardly any distinct shadow, and he concludes the patient's eye in its horizontal meridian is hypermetropic to the extent of 4·50 D. (*See* Figure.)




To prove the correctness of your observations by keratoscopy, place the patient, still under atropine, at 20 feet from the ordinary test-type card, and with such a degree of astigmatism as above he will probably only read the top letters (= $\frac{6}{6}$). Now place before the right eye, in the posterior rim of an accurately adjusted astigmatic frame a — 2·50 D. spherical lens, and in

front of this a +2 D. cylindrical glass, with its axis vertical—*i.e.*, at right angles to the horizontal or hypermetropic meridian of the eye, and on requesting the patient to read the test-types, we shall probably find his vision improved from $\frac{6}{60}$ up to $\frac{6}{12}$, or even $\frac{6}{9}$. In practice it will always be found best to order a *spherical* lens with a cylindrical glass in preference to ordering two cylinders with their axes at right angles to one another, which would be theoretically correct.

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The following is the Table referred to on page 476. In it the relation between the old and new metrical system of numbering glasses is shown :—

| *New Method, or the Dioptric System.* | | | *Old Method.* |
|---|---|---|---|
| $\frac{1}{4}$ of a | dioptric | 0·25 = | 158 |
| $\frac{1}{2}$ | ,, | 0·5 = | 79 |
| $\frac{3}{4}$ | ,, | 0·75 = | 52·3 |
| 1* | dioptric | 1 D. = | 39·5 |
| $1\frac{1}{2}$ | ,, | 1·50 D. = | 26·3 |
| 2 | ,, | 2 D. = | 19·7 |
| 3 | ,, | 3 D. = | 13·6 |
| 4 | ,, | 4 D. = | 9·9 |
| 5 | ,, | 5 D. = | 7·9 |
| 6 | ,, | 6 D. = | 6·6 |
| 7 | ,, | 7 D. = | 5·64 |
| 8 | ,, | 8 D. = | 4·9 |
| 9 | dioptric | 9 D. = | 4·4 |
| 10 | ,, | 10 D. = | 3·9 |
| 11 | ,, | 11 D. = | 3·6 |
| 12 | ,, | 12 D. = | 3·3 |
| 13 | ,, | 13 D. = | 3 |
| 14 | ,, | 14 D. = | 2·8 |
| 15 | ,, | 15 D. = | 2·6 |
| 16 | ,, | 16 D. = | 2·5 |
| 17 | ,, | 17 D. = | 2·3 |
| 18 | ,, | 18 D. = | 2·2 |
| 20 | ,, | 20 D. = | 1·9 |

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* The unit of the dioptric system (No. 1) is a lens with a focal distance of one metre, which is equal to 37 Paris inches, and to 39·4 English inches, but for practical purposes is usually reckoned as equal to 40 English inches.

# TEST TYPES,

FOR DETERMINING THE ACUTENESS OF VISION.

*Drawn up by* GEORGE COWELL, F.R.C.S.

*Surgeon to the Westminster, and Royal Westminster Ophthalmic, Hospitals, &c.*

NOTE.—These Test Types for determining the acuteness of vision, are drawn up to correspond with the series of large types of Dr. H. SNELLEN, and others. The limbs are in diameter as nearly as possible one-fifth of the height of the letters, and the figures over each size give the number of meters and feet at which the letters are seen by a standard eye. Words of one syllable are chiefly chosen as facilitating the testing of the eyes of those who read imperfectly.

A Card containing letters of each size has been printed for the convenience of carrying in the Pocket Book. G. C.

.3 (1.)

One day when the Queen of Scots, in winter, had been sitting at the window side, knitting of a work, and after the board was covered she rose and went to the fire side, and, making haste to have the work finished, would not lay it away, but worked of it the time she was warming of herself. She looked for one of her servants which, indeed, were all gone.

.45 ($1\frac{1}{2}$.)

If you doubt, I pray you ask the question, for the sooner you can advise me thither the more I shall thank you. I am sorry so sudden a chance should breed me so great a change; for methinks I am here all this while as it were in a dream, and too far from the place where I am bound to be.

.6 (2.)

I thank you for being here, and the great friendship which you have shown towards me I shall not forget. I am loath to wish you here again, but I would be very glad to be with you there. I pray you let me hear from you what you think best for me to do.

.75 ($2\frac{1}{2}$.)

The wind in the course of the storm had veered round the compass; cinders had fallen in a circle from Fleet Street to Newgate Market: and drops of lead were found far away in gardens in the suburbs, though strange to say, no life was lost, and no other house was injured.

.9 (3.)

Send some good force that ye may surely trust to in these parts. To be short with you, he is a rare bird that, by one means or other, hath not some of his with the two Earls or in his heart wisheth not well to the cause they pretend.

1.2 (4.)

The first step must not be taken by us, both for our sake and for theirs, but we may tell the Duke that those conditions being first fulfilled, he shall have what he wants.

1.5 (5.)

For two years now we have been taking the coward's road, we have found it an evil one, and it is time for us to try another. No one has a better right than I to speak of this matter: I have had much to do with them, and know their ways and their resources.

1.8 (6.)

Never again, she well knew it, would she find another Scot so true to England. She had lost her truest friend. There was none other like him in the world.

*Froude.*

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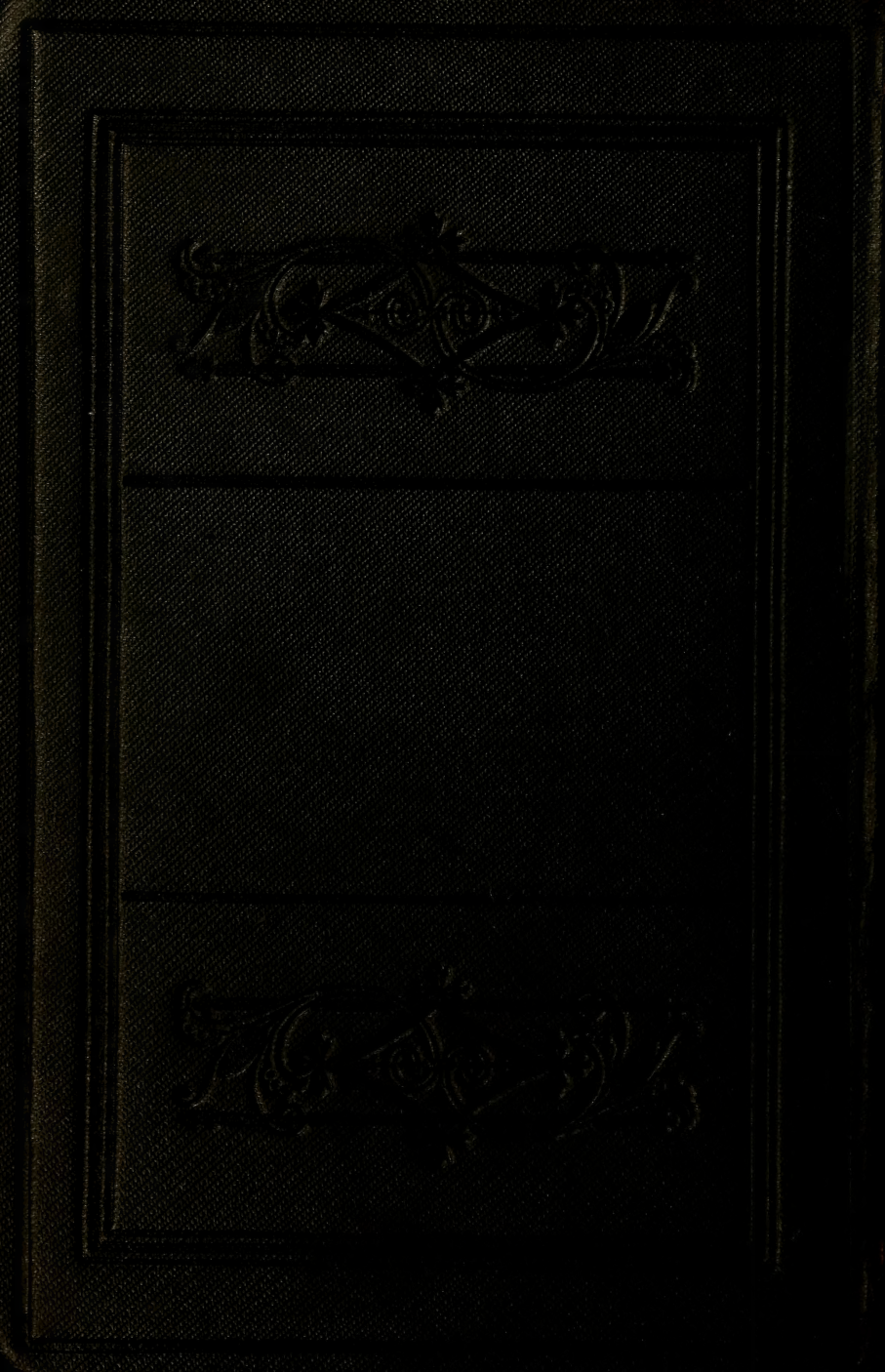
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